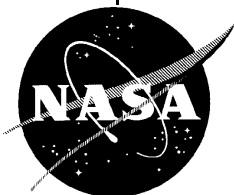


INTERFACE CONTROL DOCUMENT
Between the
GSFC DAAC TRMM SUPPORT SYSTEM (TSS)
and
THE TROPICAL RAINFALL MEASURING
MISSION (TRMM) SCIENCE DATA AND
INFORMATION SYSTEM (TSDIS)

Revision A

July 1997



National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland

INTERFACE CONTROL DOCUMENT
between the
GSFC DAAC TRMM Support System (TSS) and the
TRMM Science Data and Information System
(TSDIS)

Reviewed by:

Karen Michael
ESDIS Integration Engineer
GSFC - Code 505

Date

Dr. Gi-Kong Kim
TSDIS Deputy Project Manager
GSFC - Code 902

Date

Dr. Chris Lynnes
TSS Chief Systems Engineer
GSFC - Code 902

Date

Concurrence by:

Candace Carlisle
Interface Manager
GSFC - Code 505

Date

Greg Hunolt
DAAC and Science Operations Manager
GSFC - Code 423

Date

Approved by:

Erich Stocker
TSDIS Project Manager
GSFC - Code 902

Date

Rick Obenschain
Associate Director for ESDIS Project
GSFC - Code 423

Date

GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND

This page intentionally left blank.

Preface

This document is under ESDIS configuration control. The ESDIS has responsibility for maintenance of this ICD with support by TSDIS & TSS. Any changes in the interface definition must be agreed to by the relevant participating parties, and approved under signatures of the designated representatives of TSS, TSDIS, & ESDIS.

Any questions should be addressed to:

Configuration Management Office
Code 505
The ESDIS Project Office
Goddard Space Flight Center
Greenbelt, MD 20771

This page intentionally left blank.

Abstract

This Interface Control Document (ICD) defines the functional and physical design of each interface between the Earth Observing System Data and Information System (EOSDIS) TRMM Support System (TSS) and the Tropical Rainfall Measuring Mission (TRMM) Science Data and Information System (TSDIS), and includes the data contents and format for each interface. All modes (options) of data exchange for each interface are described as well as the conditions required for each mode or option. Additionally, data transfer frequencies message disposition settings by which anomalies are reported are included. The sequence of exchanges are completely described (e.g., required handshaking).

This ICD is consistent with the TRMM Science Requirements document, the Earth Science Data and Information System (ESDIS) Project -- Level 2 Requirements, and the Interface Requirement Document (IRD) Between EOSDIS and the TRMM Ground System.

Keywords: TRMM, TSDIS, ICD, handshaking, products, interface, TSS, GSFC, DAAC, TSU, Metadata, Ancillary data

This page intentionally left blank.

Change Information Page

| ISSUE | DATE | PAGES AFFECTED | DESCRIPTION |
|-------------------|----------------------|----------------|--|
| Baseline Rev A | 06/24/96 07/03/97 | All All | CCR 505-41-35-001-C CCR 423-41-35-001-A |

This page intentionally left blank.

List of Affected Pages

| Page No. | Revision | Page No. | Revision | Page No. | Revision | Page No. | Revision |
|----------|----------|----------|----------|----------|----------|----------|----------|
| Title | Rev A | 4-2 | Rev A | 4-26 | Rev A | | |
| i | Rev A | 4-3 | Rev A | 4-27 | Rev A | | |
| ii | Rev A | 4-4 | Rev A | 4-28 | Rev A | | |
| iii | Rev A | 4-5 | Rev A | 4-29 | Rev A | | |
| iv | Rev A | 4-6 | Rev A | 4-30 | Rev A | | |
| v | Rev A | 4-7 | Rev A | 4-31 | Rev A | | |
| vi | Rev A | 4-8 | Rev A | 4-32 | Rev A | | |
| vii | Rev A | 4-9 | Rev A | 4-33 | Rev A | | |
| viii | Rev A | 4-10 | Rev A | 4-34 | Rev A | | |
| ix | Rev A | 4-11 | Rev A | 5-1 | Rev A | | |
| x | Rev A | 4-12 | Rev A | 5-2 | Rev A | | |
| xi | Rev A | 4-13 | Rev A | 5-3 | Rev A | | |
| xii | Rev A | 4-14 | Rev A | 5-4 | Rev A | | |
| xiii | Rev A | 4-15 | Rev A | 5-5 | Rev A | | |
| xiv | Rev A | 4-16 | Rev A | 5-6 | Rev A | | |
| 1-1 | Rev A | 4-17 | Rev A | 5-7 | Rev A | | |
| 1-2 | Rev A | 4-18 | Rev A | 5-8 | Rev A | | |
| 2-1 | Rev A | 4-19 | Rev A | 5-9 | Rev A | | |
| 2-2 | Rev A | 4-20 | Rev A | 5-10 | Rev A | | |
| 2-3 | Rev A | 4-21 | Rev A | A-1 | Rev A | | |
| 2-4 | Rev A | 4-22 | Rev A | A-2 | Rev A | | |
| 3-1 | Rev A | 4-23 | Rev A | A-3 | Rev A | | |
| 3-2 | Rev A | 4-24 | Rev A | A-4 | Rev A | | |
| 4-1 | Rev A | 4-25 | Rev A | | | | |

This page intentionally left blank.

Contents

PREFACE

ABSTRACT

1. INTRODUCTION

| | |
|-------------------------------|-----|
| 1.1 Purpose----- | 1-1 |
| 1.2 Status and Schedule ----- | 1-1 |
| 1.3 Organization----- | 1-1 |

2. RELATED DOCUMENTATION

| | |
|--------------------------------|-----|
| 2.1 Parent Documents ----- | 2-1 |
| 2.2 Applicable Documents ----- | 2-1 |
| 2.3 Information Documents----- | 2-3 |

3. INTERFACE OVERVIEW

4. DATA EXCHANGE FRAMEWORK

| | |
|--|-----|
| 4.1 TSS-TSDIS Network Topology ----- | 4-1 |
| 4.1.1 Network and Transport Protocol ----- | 4-1 |
| 4.1.2 Physical Network Topology----- | 4-1 |
| 4.1.3 E-mail Interface ----- | 4-1 |
| 4.1.4 File Transfer ----- | 4-1 |
| 4.1.5 Gateway Interface ----- | 4-2 |
| 4.1.6 Other Security Considerations ----- | 4-2 |

| | |
|--|------|
| 4.2 TSS TSDIS Gateway Interface Details | 4-2 |
| 4.2.1 Authentication Request Message Definition | 4-3 |
| 4.2.2 Authentication Response Message Definition | 4-3 |
| 4.2.3 Close Session Message Definition | 4-4 |
| 4.3 Handshake Control Messages and File Transfer Sequences | 4-5 |
| 4.3.1 TSS Retrieves Data from TSDIS to Archive | 4-6 |
| 4.3.2 TSDIS Requests/Retrieves Data from TSS | 4-8 |
| 4.3.2.1 Data Request Scenario | 4-8 |
| 4.3.2.2 Data Subscription Scenario | 4-9 |
| 4.3.3 TSDIS Orders Data from TSS for TSUs | 4-11 |
| 4.3.4 TSDIS Sends Updated Metadata | 4-13 |
| 4.4 Message Format and Contents Overview | 4-13 |
| 4.4.1 Data Availability Notice (DAN) | 4-14 |
| 4.4.2 Data Availability Acknowledgment (DAA) | 4-22 |
| 4.4.3 Data Delivery Notice (DDN) | 4-25 |
| 4.4.4 Data Delivery Acknowledgment (DDA) | 4-26 |
| 4.4.5 Data Request (DR) | 4-28 |
| 4.4.6 Data Request Acknowledgment (DRA) | 4-30 |
| 4.4.7 Metadata Update Request (MUR) | 4-32 |
| 4.4.8 Metadata Update Acknowledgment (MUA) | 4-33 |
| 4.4.9 Granule-Standing-Order Map | 4-34 |

5. PRODUCT/DATA FLOW DESCRIPTIONS

| | |
|---------------------------------|-----|
| 5.1 HDF-EOS Data Taxonomy | 5-2 |
| 5.2 Metadata | 5-3 |

| | |
|--|------|
| 5.3 TSDIS to TSS/GSFC Interface | 5-3 |
| 5.3.1 TRMM TMI, PR, VIRS, Combined, and GV Data and Products..... | 5-3 |
| 5.3.2 TRMM Orbit Ephemeris | 5-4 |
| 5.3.3 TRMM Level 0 Housekeeping Data | 5-5 |
| 5.3.4 TRMM TMI, PR, VIRS, Combined, and GV Algorithms and Documentation..... | 5-5 |
| 5.4 TSS/GSFC to TSDIS Interface | 5-7 |
| 5.4.1 TRMM TMI, PR, VIRS, Combined and GV Levels 1A-3B Data for Reprocessing- | 5-7 |
| 5.4.2 TRMM Orbit Ephemeris | 5-8 |
| 5.4.3 TRMM Level 0 Housekeeping Data | 5-8 |
| 5.5 Ancillary Data..... | 5-8 |
| 5.5.1 Climate Analysis and Monitoring System (CAMS) | 5-8 |
| 5.5.2 GOES Precipitation Index (GPI) | 5-9 |
| 5.5.3 Global Precipitation Climatology Center (GPCC)..... | 5-9 |
| 5.5.4 National Meteorological Center (NMC) Final Analysis and Forecast System..... | 5-9 |
| 5.6 TSS to TSU Interface | 5-10 |
| 5.7 Product Schedules | 5-10 |
| 5.7.1 TSDIS Product Schedule | 5-10 |
| 5.7.2 TSDIS Delayed Product Status | 5-10 |

APPENDIX A. ABBREVIATIONS AND ACRONYMS

This page intentionally left blank.

1. Introduction

1.1 Purpose

This document is written to formalize the interpretation and general understanding of the interfaces between TSS and TSDIS. The purpose of these interfaces is for TSS to archive TRMM science data products, distribute TRMM products to TSDIS for reprocessing, distribute ancillary data to TSDIS for processing and reprocessing, and distribute TRMM products to TSDIS Science Users (TSUs). This document provides clarification and elaboration of these interfaces to the extent necessary to assure hardware, software, and operational service compatibility within the end-to-end system.

This document provides a point of mutual control of external interface definitions for the ESDIS and TSDIS Configuration Control Boards (CCBs).

1.2 Status and Schedule

At the Government's option, this document will be under full Government CCB control. Changes may be submitted at any time for consideration by Contractor and Government CCBs under the normal change process.

1.3 Organization

This document is organized in 5 sections plus appendices. Section 1 provides information regarding the purpose of this document. Section 2 contains information about documentation relevant to this ICD, including parent, applicable, and information documents. Section 3 provides an overview of the interfaces, with a brief description of the institutions involved. Section 4 provides an overview of the data exchange approaches. Section 5 defines the contents and formats for each data exchange between TSS and TSDIS, and a description of the TSDIS and ancillary data products involved. Appendix A contains a workoff plan for TBRs, TBDs, and TBSs. Acronyms and abbreviations are included in Appendix B.

This page intentionally left blank.

2. Related Documentation

2.1 Parent Documents

The following documents are the parents from which this document's scope and content is derived.

| | |
|--------------|---|
| 423-10-01-1 | Goddard Space Flight Center, Earth Science Data and Information System (ESDIS) Level 2 Requirements EOSDIS Core System (ECS), Volume 1 |
| 423-10-04 | Goddard Space Flight Center, Memorandum of Understanding Between the Tropical Rainfall Measuring Mission (TRMM) Project and the EOS Ground System and Operations Project (GSOP) for Science Data Archive and Distribution Support |
| 505-10-20 | Goddard Space Flight Center, System Interface Control Plan for the Earth Science and Data Information System (ESDIS) Project |
| 505-10-23 | Goddard Space Flight Center, Earth Observing System Data and Information System (EOSDIS) Security Plan and Guidelines |
| 505-41-14 | Goddard Space Flight Center, Interface Requirements Document Between the Earth Observing System Data and Information System (EOSDIS) and the Tropical Rainfall Measuring Mission (TRMM) Ground System |
| TRMM 490-003 | Goddard Space Flight Center, Tropical Rainfall Measuring Mission (TRMM) System Specification -- Ground Segment |
| TSDIS P-200 | Goddard Space Flight Center, TSDIS Requirements Document, Revision 5 |

2.2 Applicable Documents

The following documents are referenced herein and are directly applicable to this document. In the event of conflict between any of these documents and this document, this document shall take precedence.

| | |
|----------------|--|
| 175-WP-001-001 | HDF-EOS Primer for Version 1 EOSDIS, White Paper for the ECS Project |
| TRMM-490-137 | Goddard Space Flight Center, Tropical Rainfall Measuring Mission (TRMM) Telemetry and Command Handbook |

| | |
|-------------------|---|
| TSDIS P-907 | Goddard Space Flight Center, Interface Control Specification Between the TSDIS and the TSU, Volume 3: File Specifications for TSDIS Products - Level 1 |
| TSDIS P-907 | Goddard Space Flight Center, Interface Control Specification Between the TSDIS and the TSU, Volume 4: File Specifications for TSDIS Products - Level 2 and Level 3 |
| TSDIS-1992-REQ-00 | Goddard Space Flight Center, TRMM Science Requirements |
| 510-203.103 | Goddard Space Flight Center, Interface Control Document Between the Sensor Data Processing Facility (SDPF) and the Tropical Rainfall Measuring Mission (TRMM) Consumers |
| 540 - 032 | Goddard Space Flight Center, EBnet - Distributed Active Archive Center (DAAC) Interface Control Document (ICD) |
| 540 - 047 | Goddard Space Flight Center, EBnet - TRMM Science Data and Information System (TSDIS) Interface Control Document (ICD) |
| ON 388 | U.S. Department of Commerce; National Oceanic and Atmospheric Administration (NOAA) Office Note 388; Unreviewed manuscript: The WMO Format for the Storage of Weather Product Messages in Gridded Binary Form (GRid In Binary [GRIB] data format) |
| CCSDS 301.0-B-2 | Consultative Committee for Space Data Systems (CCSDS) Recommendation for Space Data System Standards: Time Code Formats, Blue Book, Issue 2 |
| CCSDS 620.0-B-2 | Consultative Committee for Space Data Systems (CCSDS) Recommendation for Space Data System Standards: Standard Formatted Data Units -- Structure and Construction Rules, Blue Book |
| CCSDS 641.0-B-1 | Consultative Committee for Space Data Systems (CCSDS), Recommendation for Space Data System Standards: Parameter Value Language Specification (CCSDS0006), Blue Book |
| RFC 791 | Internet Protocol, J. Postel (<i>WWW access: gopher://ds.internic.net:70/</i>) |
| RFC 793 | Transmission Control Protocol, J. Postel (<i>WWW access: gopher://ds.internic.net:70/</i>) |
| RFC 821 | Simple Mail Transfer Protocol (SMTP), J. Postel (<i>WWW access: gopher://ds.internic.net:70/</i>) |
| RFC 822 | Standard for the Format of Advanced Research Projects Agency (ARPA) Internet Text Messages, D. Crocker (<i>WWW access: gopher://ds.internic.net:70/</i>) |

| | |
|----------|--|
| RFC 959 | File Transfer Protocol, Internet Standards, J. Postel, J. Reynolds (<i>WWW access: gopher://ds.internic.net:70/</i>) |
| RFC 1157 | A Simple Network Management Protocol (SNMP), J. Case, M. Fedor, M. Schoffstall, J. Davin (<i>WWW access: gopher://ds.internic.net:70/</i>) |
| none | HyperText Markup Language Specification Version 3.0, Internet Draft, D. Raggett |
| none | HyperText Transfer Protocol Version 1.0, Internet Draft, T. Berners-Lee, R. Fielding, H. Frystyk |
| none | TSDIS /GSFC DAAC TSS Operations Agreement |

2.3 Information Documents

The following documents, although not directly applicable, amplify or clarify the information presented in this document, but are not binding.

| | |
|----------------|---|
| 490-010 | Goddard Space Flight Center, TRMM Project Data Management Plan |
| 500-135 | Goddard Space Flight Center, Detailed Mission Requirements (DMR-2) for TRMM |
| 553-FDD-91/028 | Goddard Space Flight Center, Flight Dynamics Division (FDD) Interface Control Document for Generic Data Product Formats |
| TSDIS-P800 | Goddard Space Flight Center, TRMM Science Data and Information System (TSDIS) Operations Concept |
| TSDIS-P402 | Goddard Space Flight Center, TSDIS Segment Operations Scenarios |
| TSDIS P-403 | Goddard Space Flight Center, TSDIS Software Design Specification |

This page intentionally left blank.

3. Interface Overview

TSDIS and TSS work together to provide support for the Visible and Infrared Scanner (VIRS), TRMM Microwave Imager (TMI), and Precipitation Radar (PR) instruments flown on the TRMM observatory, and corresponding Ground Validation (GV) data. The TSS components involved in this interface reside at and are operated by the Goddard Space Flight Center (GSFC) Distributed Active Archive Center (DAAC). This support includes science data archive and distribution.

TRMM is a Mission to Planet Earth mission designed to advance our understanding of total rainfall and to determine the rate of rainfall and the total rainfall occurring over the tropics and subtropics (between +35 and -35 degrees latitude). TRMM is also designed for the measurement and analysis of the Earth's radiant energy budget and lightning. The mission is a joint venture between National Aeronautics and Space Administration (NASA) and the National Space Development Agency of Japan (NASDA). The TRMM observatory is scheduled to be launched in November 1997.

TSDIS is located at GSFC and houses the TRMM Science Data Operations Center (SDOC) and the Science Operations Control Center (SOCC). TSDIS processes PR, TMI, VIRS, and GV data to generate various levels of standard data products. The TSDIS-generated science data products are made available to the TSDIS Science Users (TSUs) (algorithm developers, instrument scientists, and quality control scientists) through Remote Science Terminals (RSTs) and via TSS. In addition, these standard data products are transferred from TSDIS to TSS for archive and distribution by TSS, and for later retrieval by TSDIS for reprocessing. TSDIS also has the capability to function as a proxy to request data from TSS for the TSUs. TSS provides the requested data directly to the TSUs. All TSUs are registered users of TSS.

The GSFC DAAC supports research in the discipline areas of the upper atmosphere, atmospheric dynamics, global biosphere, and geophysics. The TSS components of the GSFC TSS DAAC has responsibility for archive and distribution of TMI, PR, and VIRS data products, combined products which include PR and/or TMI data and other data, GV data products, metadata, level 0 housekeeping, orbit ephemeris, and ancillary data.

Figure 3-1 is a high-level illustration of these interfaces. See Figure 5-1 for a detailed illustration of the data flows between the interfaces.

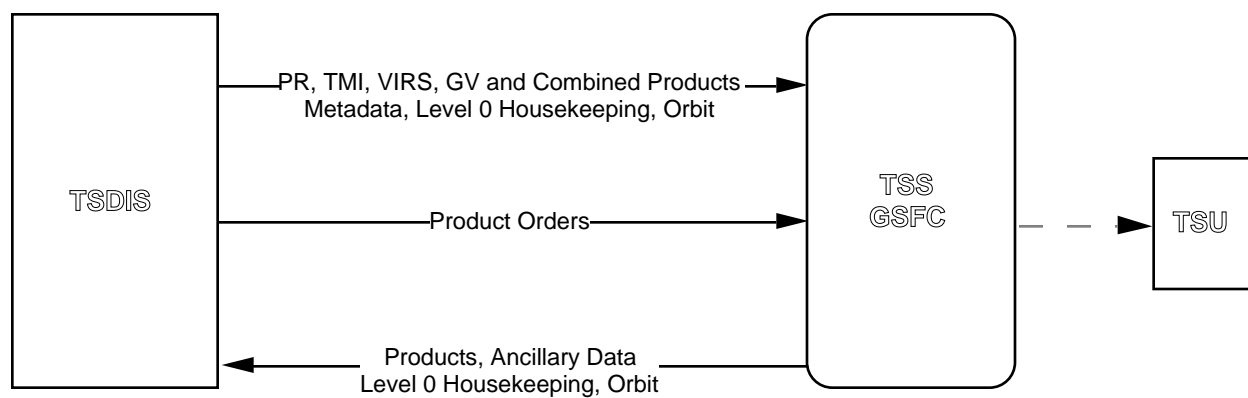


Figure 3-1. TSS/TSDIS Interface Overview

4. Data Exchange Framework

Section 4 defines the data exchange framework for the network interface, message flows, and file transfers between TSS and TSDIS. Section 4.1 provides an overview of the network topology, e-mail and HTML interfaces, file transfer protocol, TSS TSDIS Gateway interface, and security considerations. Section 4.2 discusses the TSS TSDIS Gateway interface requirements and control messages. Section 4.3 introduces the handshake control messages involved in the data exchanges and shows the various sequences in which they are used. Section 4.4 provides the format and content of the handshake control messages.

4.1 TSS-TSDIS Network Topology

4.1.1 Network and Transport Protocol

The network protocol used for TSDIS - TSS communication is the Internet Protocol (IP), specified in RFC 791. The network layer provides the transparent transfer of data between transport entities. IP addresses for the network nodes and data hosts for this interface are determined prior to installation at the facilities.

The transport protocol used for TSDIS - TSS communication is the Transmission Control Protocol (TCP), providing reliable delivery of data. TCP is specified in RFC 793.

4.1.2 Physical Network Topology

The physical network interface between TSDIS and TSS is provided by the EOSDIS Backbone Network (EBnet). The TSDIS - EBnet interface is specified in the EBnet - TRMM Science Data and Information System (TSDIS) ICD.

4.1.3 E-mail Interface

TSS notifies TSUs of data availability of an order forwarded to TSS by TSDIS through Internet e-mail messages. E-mail is sent using the Simple Mail Transfer Protocol (SMTP), documented in RFC 821 and RFC 822.

4.1.4 File Transfer

All file transfers between TSS and TSDIS are conducted through the use of ftp. Standard File Transfer Protocol (ftp), as described in RFC 959, is an Internet standard for file transfers that supports retrieval of files from a remote server, with security provided by the requirement of a User ID and password. All ftp data exchanges between TSS and TSDIS are automated and pulled by the consumer system (Computer Based Interface [CBI] Get), using "get" or "mget" commands. A "get" command is used to transfer one file, while an "mget" command is used to transfer multiple files. File transfers from TSS to the TSUs are conducted by the TSUs (usually not automated) using the standard ftp "get" or "mget" commands. TSS and TSUs must both

host ftp software for this interface. TSDIS and TSS ftp daemons may be resident on several different servers. Files are obtained from one of these workstations in each ftp session.

For file transfers from TSS to TSUs, TSS data are staged in randomly-generated directories (one for each Data Request) whose names cannot be listed through FTP. However, a user who knows the directory name can change to it (i.e., chdir or cd) and list and retrieve the contents. This directory name is sent to the user in the email confirmation when the data are staged.

4.1.5 Gateway Interface

All message interactions between TSDIS and TSS are done through TCP/IP connections between the TSS TSDIS Gateway and TSDIS. Message contents are in network byte order. For connections initiated by TSDIS, a TSDIS client communicates with an TSS server; for connections initiated by TSS, an TSS client communicates with a TSDIS server.

4.1.6 Other Security Considerations

Only TSDIS users (TSUs and designated TSDIS personnel) are authorized to access or query the TSDIS data from launch through the first 6 months after the TRMM mission instrument checkout phase. After this time period, data access can be unrestricted by the TSS GSFC DAAC administrator upon TSDIS request. The Clouds and Earth's Radiant Energy System (CERES) and Lightning Imaging Sensor (LIS) (EOS instruments also flown on the TRMM spacecraft) science teams are included in this access list because they use TSDIS data as part of their data processing.

4.2 TSS TSDIS Gateway Interface Details

The TSS Gateway interface with TSDIS involves a set of control messages, which are needed to support the Gateway functions. The messages are listed in Table 4-1

Table 4-1. Gateway Control Messages

| Message Name | Description | Sender |
|-------------------------|---|-------------|
| Authentication Request | Sent at the beginning of the session to authenticate the client | TSDIS & TSS |
| Authentication Response | Sent in response to the authentication request to report a success or failure | TSDIS & TSS |
| Close Session | Sent at the end of the session to notify the intent to terminate the connection | TSDIS & TSS |

4.2.1 Authentication Request Message Definition

Connections may be initiated by either the TSS or the TSDIS for application program-to-application program communication. After the connection is established, the initiating system must send an Authentication Request to the host system (refer to Table 4-2). This formatted message is sent from one system to another via TCP. When the host system rejects the Authentication Request, the connection will be broken. The number of times the initiating system will attempt authentication, is an operations tunable parameter.

Table 4-2. Authentication Request Message Definition

| Field | Type (Length) | Value |
|--------------------|-----------------------|----------------------------------|
| Message Type | Unsigned Integer (1B) | 15 - Authentication Request |
| Message Length | Unsigned Integer (3B) | ≤ 84- Length of Message in Bytes |
| Destination System | ASCII String (≤20B) | Communications Server |
| Origination System | ASCII String (≤20B) | Communications Client |
| UserID | ASCII String(≤20 B) | User provided identification |
| Password | ASCII String(≤20 B) | Authentication parameter |

4.2.2 Authentication Response Message Definition

The Authentication Response is sent as a formatted message using TCP as an application process-application process message (refer to Table 4-3). Note that the "Destination System" field is the same system referred to in the "Destination System" field of the Authentication Request message.

Table 4-3. Authentication Response Message Definition

| Field | Type (Length) | Value |
|-------------------------------|-----------------------|---------------------------------|
| Message Type | Unsigned Integer (1B) | 16 - Authentication response |
| Message Length | Unsigned Integer (3B) | ≤45- Length of Message in Bytes |
| Destination System | ASCII String (≤20 B) | Communications Server |
| Origination System | ASCII String (≤20 B) | Communications Client |
| Authentication Disposition | Integer (1B) | 1-Accepted 2-Rejected |

4.2.3 Close Session Message Definition

During a session and following an accepted Authentication Response, one or more sets of messages may be exchanged. Upon completion of a session a Close Session message is sent as a notification that the session is closed and the connection is then terminated (refer to Table 4-4). A session remains open until a Close Session message is sent by either one of TSS or TSDIS and received by the other.

Table 4-4. Close Session Message Definition

| Field | Description | Type (Length in Bytes) | Value |
|-----------------------------------|--|---------------------------|-------------------------------------|
| Message Type | Type of Message (Gateway Control Message) | Integer (1) | 0 |
| Message Length | Length of Message in Bytes | Integer (3) | 16 |
| Enumerated Type | Type of Gateway Control Message (Close Session = 2) | Integer (4) | 2 |
| Socket Notification Flag | Indicates whether gateway socket interface should be notified of closure of session 1 is true; 0 is false | Integer (4) | 0 or 1 |
| Internal Server Notification Flag | Indicates whether internal server should be notified (with same message) of session closure; 1 is true; 0 is false | Integer (4) | 0 or 1 (usually 1 for TSDIS) |

4.3 Handshake Control Messages and File Transfer Sequences

Initiation and completion of data transfer requires automated transmission of handshake control messages, or domain messages, between TSS and TSDIS. These messages, which are based on the Sensor Data Processing Facility (SDPF) CBI Get Protocol, are transferred between TSDIS and TSS via a TCP/IP connection between TSDIS and the TSS Gateway, as shown in Figures 4-1 through 4-4. The pairs of vertical lines indicate the TSDIS and TSS sides of the interface and define separate sessions, each involving either a TCP/IP socket connection and termination or a ftp connection and termination. The originator of the connection generally terminates (closes) the connection though either party may terminate a connection if the other party has been inactive after an operations tunable amount of time. Table 4-5 lists the messages involved before and after an electronic file transfer. These messages are defined in Sections 4.4.1 through 4.4.8.

Table 4-5 Handshake Control Messages

| Message Name | Purpose | Description | Sender |
|--|---|---|---------------|
| Data Availability Notice (DAN) | Notification of Data Ready for Transfer | System with data notifies Consumer system that the data are staged and ready for transfer. | TSDIS and TSS |
| Data Availability Acknowledgment (DAA) | DAN Handshake | Consumer system acknowledges that the DAN has been received, and notifies of any DAN errors | TSDIS and TSS |
| Data Delivery Notice (DDN) | Notification of Data Transfer | Consumer system notifies that data has been transferred, ingested and archived; includes identification of data retrieval success and/or problems | TSDIS and TSS |
| Data Delivery Acknowledgment (DDA) | DDN Handshake | System with data notifies Consumer system that the DDN has been received, which indicates that the data can be deleted from the staging area | TSDIS and TSS |
| Data Request | Request data | TSDIS requests data from the TSS archive | TSDIS |
| Data Request Acknowledgment | Data Request Handshake | TSS acknowledges to TSDIS that the Data Request has been received and is or is not valid | TSS |
| Metadata Update Request | Update QA Metadata | TSDIS sends TSS updated QA metadata parameters after product QA | TSDIS |
| Metadata Update Acknowledgment | Metadata Update Notification | TSS notifies TSDIS that QA Metadata parameters have been updated | TSS |

4.3.1 TSS Retrieves Data from TSDIS to Archive

The sequence of Gateway and handshake control messages, and file transfers needed for TSS to retrieve data from TSDIS is illustrated in Figure 4-1.

TSDIS opens the TCP/IP connection to the TSS Gateway and sends TSS an Authentication Request message. TSS returns an Authentication Response. After successful authentication, TSDIS then sends a Data Availability Notice (DAN) message to TSS, specifying the names of the data files, file sizes, file dates and times, number of files, and file locations for the files available for TSS to archive (see Tables 4-6 and 4-7 for the full DAN contents). TSS validates the DAN, and sends the corresponding handshake control message, the Data Availability Acknowledgment (DAA), which reports the disposition of the DAN.

It is possible to send more than one DAN within a TCP/IP session; however another DAN cannot be sent until the acknowledgment (DAA) is received for the previous DAN. Each DAN is distinguished from the others by the sequence number and processor identifier which created it. These parameters are included in the DAN message. After all DANs have been acknowledged, TSDIS closes the session.

When ready, TSS begins the ftp file transfer process, and transfers all the files listed in the DAN. Each file is verified, by checking its name and size against DAN information; metadata is extracted; and the file transfer result is logged in the Data Delivery Notice (DDN). After all the files have been transferred, ingested, and archived or when all attempts have been exhausted, TSS opens a new TCP/IP connection and sends TSDIS a DDN notifying whether files were successfully archived and/or identifying errors associated with individual files for a particular DAN. TSDIS responds with the corresponding handshake control message, the Data Delivery Acknowledgment (DDA). TSS terminates the connection after all DDNs have been acknowledged by TSDIS. A DDA disposition returned by TSDIS of 2 indicates that TSDIS had problems processing the DDN through their system (i.e., database failure); TSS re-establishes the connection and resends the DDN an operations tunable amount of time later.

In the case of failure in file transfer and archive, due to an error in the DAN, TSDIS corrects the error and sends a new DAN. If there is a network failure during or before file transfer, TSS retries an operations-tunable number of times. If the retry is successful, no retransmission of the DAN is required from TSDIS. If unsuccessful after all retries, an email or voice alert is sent to the TSS operator. The TSS operator interfaces with the TSDIS operator for resubmittal of the DAN. TSS is not required to ingest data from TSDIS via physical media, since TSDIS is capable of storing a minimum of 3 days worth of data. Files that have been successfully archived within TSS are eligible for deletion at TSDIS.

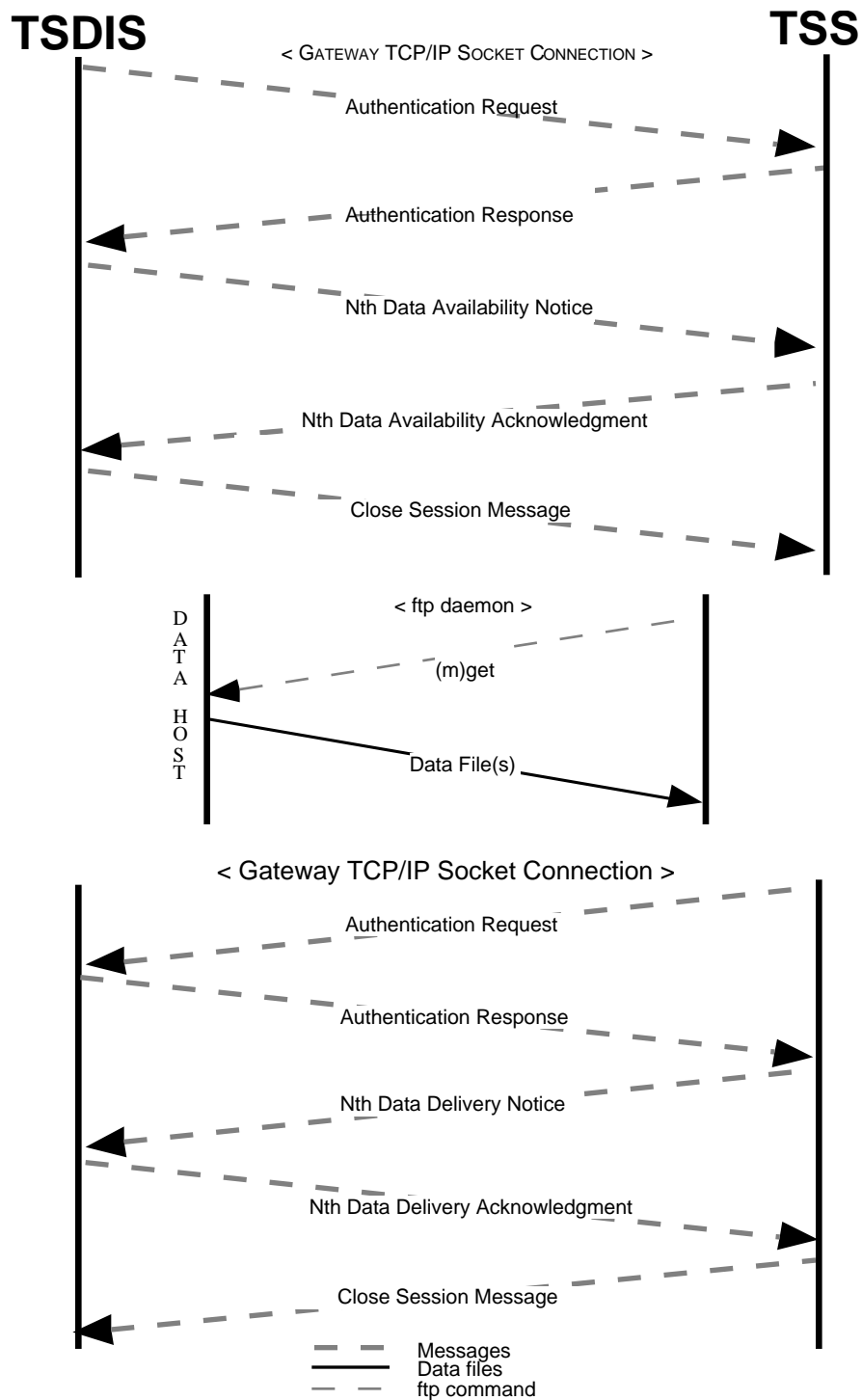


Figure 4-1. TSS Retrieves Data from TSDIS

4.3.2 TSDIS Requests/Retrieves Data from TSS

The sequence of Gateway and handshake control messages, and file transfers needed for TSDIS to request and retrieve data from TSS is illustrated in Figure 4-2. Data ordered by the Data Request is described in more detail in Section 4.4.5. Both the Data Request and the Data Subscription scenarios are described below.

4.3.2.1 Data Request Scenario

TSDIS opens the TCP/IP connection to the TSS Gateway, and sends the Authentication Request message. TSS returns the Authentication Response message. After successful authentication, TSDIS sends a Data Request message to TSS, ordering the data needed for reprocessing. After receipt of the Data Request, TSS sends the Data Request Acknowledgment (DRA) message, which reports the disposition of the Data Request. If the disposition is not successful, then TSS does not stage the data; instead, TSDIS resubmits a valid Data Request. If the disposition is successful, TSS retrieves all the requested data from the archive and places it on the file server in a timely manner after sending the DRA message to TSDIS. The actual turnaround times depend on the volume of data requested and the network load. TSDIS may send another Data Request after receiving a DRA; TSDIS closes the session, after receiving the last DRA. Refer to Sections 4.4.5 and 4.4.6 for more information on the Data Request and DRA messages.

When the data have been staged, TSS opens a TCP/IP connection and sends a DAN message to TSDIS. The DAN specifies the number of files, file sizes, file names and directory paths for the files available for TSDIS to ftp from the TSS file server (see Tables 4-6 and 4-7 for the full DAN contents). More than one DAN can be sent for each Data Request. TSDIS sends the corresponding handshake control message, the Data Availability Acknowledgment (DAA), which reports the disposition of the DAN. TSS evaluates the disposition; the TSS operator interfaces with the TSDIS operator to complete the Data Request, as appropriate.

It is possible to send more than one DAN within a TCP/IP session; however another DAN cannot be sent until the acknowledgment (DAA) is received for the previous DAN. Each DAN is distinguished from the others by the sequence number and processor identifier which created it. These parameters are included in the DAN message. TSS terminates the connection after sending all available DANs and receiving the corresponding acknowledgments.

When ready, TSDIS begins the ftp file transfer process using an account and password supplied by the GSFC DAAC and transfers all the files in each file group listed in the DAN. Each file is checked against DAN information, and the file transfer result is logged for the Data Delivery Notice (DDN). After all the files have been transferred successfully or transfer attempts have been exhausted, TSDIS opens a new TCP/IP connection with TSS, sending the Authentication Request message and receiving the authentication response from TSS. After successful authentication, TSDIS sends TSS a DDN notifying whether files were successfully retrieved and validated and/or identifying errors associated with individual files for a particular DAN. TSDIS ingests only files that are transferred without error. TSS responds with the corresponding handshake control message, the Data Delivery Acknowledgment (DDA). If TSDIS sends a long DDN indicating that some files could not be ingested, TSS sends a new DAN for just those files (with the same expiration time as in the initial DAN, and in a new TCP/IP session). One or more

sets of DDN and DDA messages may be exchanged during the session. TSDIS then closes the connection.

Files are eligible for deletion from the TSS file server after the expiration time parameter specified in the DAN by TSS, or after the files have been successfully retrieved (whichever is earlier). If the file transfer cannot be completed before the expiration time, TSDIS is required to submit a new request for the data (Data Request). The expiration time interval after the DAN is sent depends on the available space on the file server.

In cases of problems in file transfers (ftp), data transfer attempts are repeated an operations tunable number of times. If unsuccessful after all retries, an alert is sent to the TSDIS operator. The TSDIS operator interfaces with the TSS operator to verify that the interface is operational. TSS does not provide data to TSDIS via physical media.

4.3.2.2 Data Subscription Scenario

Based on the ancillary data specifications in section 5.5, TSS enters a Data Subscription on behalf of TSDIS. Subsequent changes during the TRMM mission, i.e., cancellation of existing orders or addition of ancillary products, will be documented as CCRs to this ICD.

When the TSDIS subscriptions are entered into the TSS database, TSS operators will transmit the SUBSCRIPTION_IDS to TSDIS verbally or via email.

When the ancillary data are inserted into the TSS archive, TSS opens a TCP/IP connection to a predefined TSDIS IP address and sends a DAN message. The rest of the scenario is the same as for a Data Request.

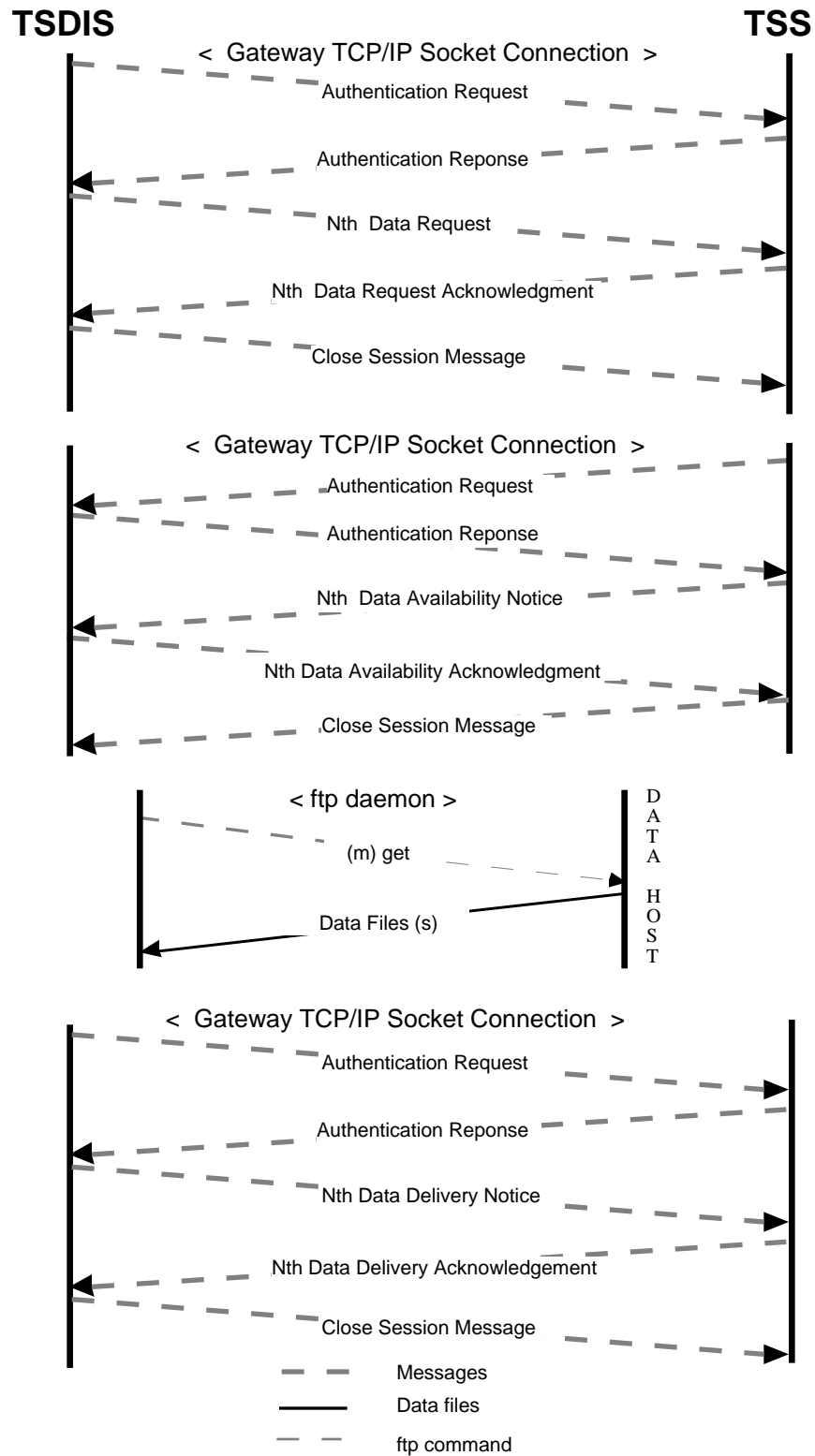


Figure 4-2. TSDIS Requests/Retrieves Data from TSS

4.3.3 TSDIS Orders Data from TSS for TSUs

The sequence of Gateway and handshake control messages and file transfers needed for TSUs to obtain data from TSS via TSDIS is illustrated in Figure 4-3.

TSDIS establishes a TCP/IP connection and sends the Authentication Request message; TSS returns the Authentication Response. After successful authentication, TSDIS sends a Data Request message to TSS to order the data on behalf of a TSDIS Science User (TSU). This request indicates how the data are to be delivered; either electronically (the TSU pulls the data from TSS, via ftp over the Internet) or via TSS standard 8 mm tape media (TSS puts the data on 8 mm tape and mails the tape to the TSU). TSS sends the corresponding handshake control message, the Data Request Acknowledgment (DRA), which reports the disposition of the Data Request. TSDIS may send another Data Request after receipt of a DRA. TSS sends a mail-item to the TSU to acknowledge receipt of the order.. TSDIS terminates the connection after receiving the last DRA expected. TSS then retrieves the requested data, if available, from the archive and places it on the file server or copies it to 8 mm tape. TSS sends a human-readable notification via e-mail to the TSU when a Data Request has been filled. If there is an unrecoverable error filling the request a TSS operator will send e-mail to the TSU. The notification for electronic delivery indicates to the TSU the location of the data and the expiration time. For 8 mm tape media delivery, TSS sends the e-mail notification indicating to the TSU that the tape has been mailed to the TSU facility (on the order of 1 business day after receiving the Data Request from TSDIS).

If delivery of the data to the TSU is requested to be done electronically, the TSU transfers all the files listed in the e-mail notification using ftp. Files are eligible for deletion from the TSS file server after the expiration time specified in the notification, or after the files have been successfully retrieved, whichever is earlier. If the file transfer cannot be completed before the expiration time, the TSU is required to submit a new order for the data. The expiration time interval after the notification is sent depends on the available space on the file server. A minimum time interval is set by the GSFC DAAC, and will be included in the DAAC-specific operations procedures in the DAAC Operators Manual.

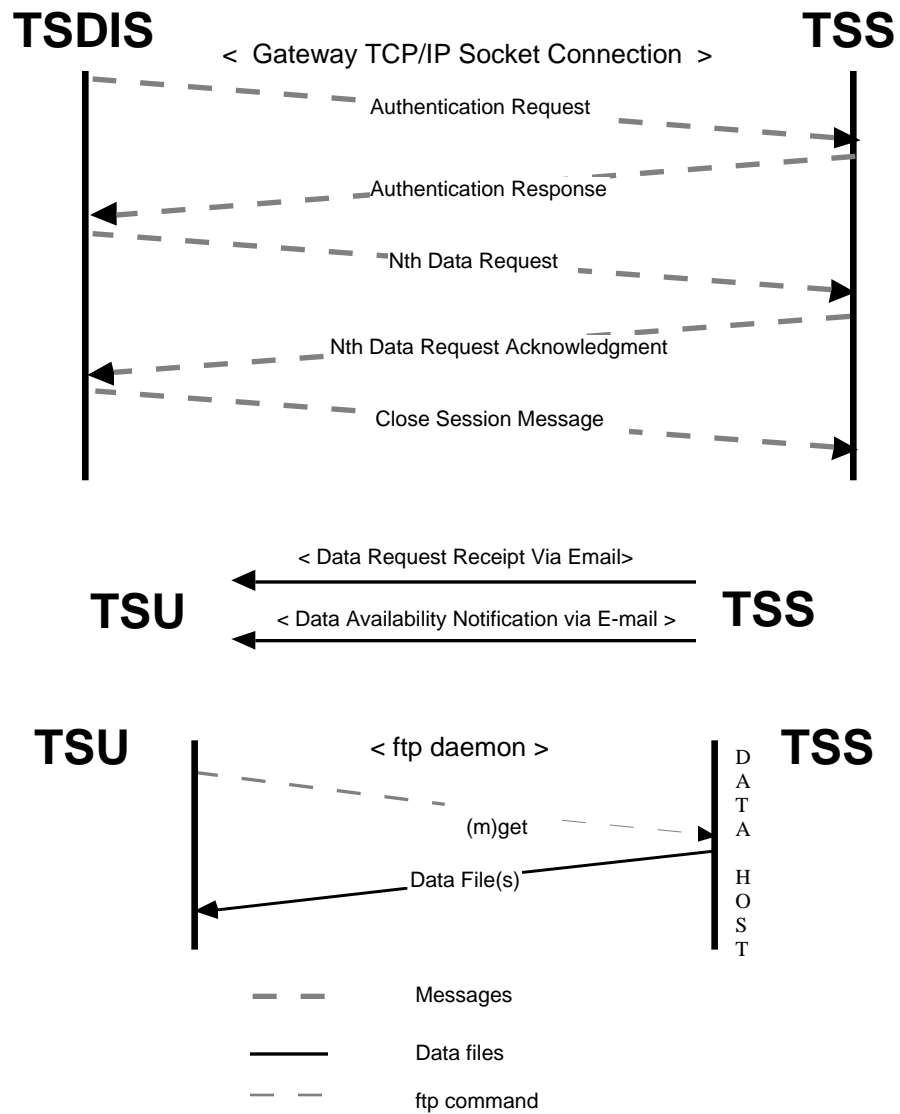


Figure 4-3. TSDIS Requests Data for TSUs

4.3.4 TSDIS Sends Updated Metadata

Figure 4-4 shows the sequence of Gateway and handshake control messages involved for TSDIS to send updated metadata to TSS for products already in the archive. When TSDIS needs to send updated Quality Flag metadata, it sends a Metadata Update Request message to TSS. TSS then sends a Metadata Update Acknowledgment message, which either states that the metadata have been successfully updated or it states the disposition of the Metadata Update Request message.

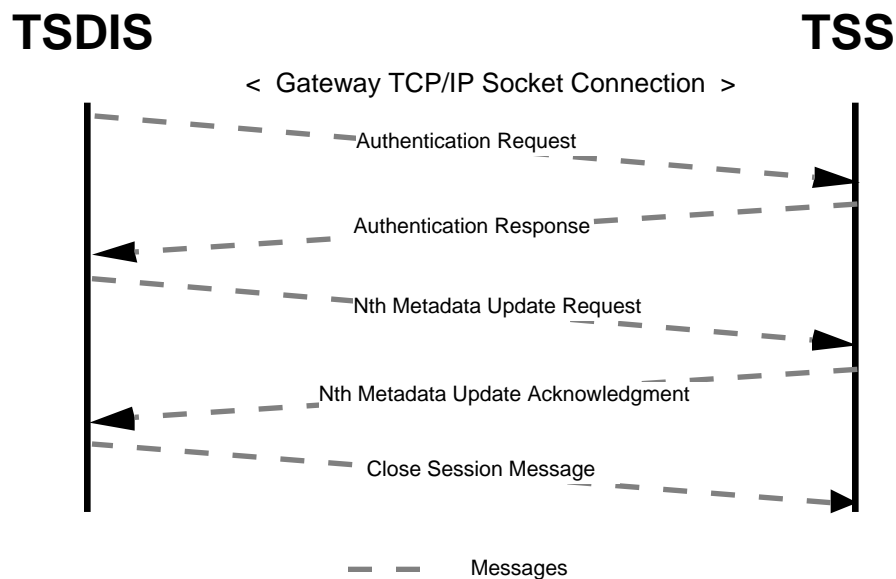


Figure 4-4. TSDIS Requests Metadata Update

4.4 Message Format and Contents Overview

The handshake control messages are identified in Table 4-5. The message formats contain both fixed and variable length strings. A zero byte (NULL character) is used as a field separator for variable length strings in the manner of the C programming language, except in the Parameter Value Language (PVL) as noted in Section 4.4.1. Field lengths are specified in terms of bytes, where a byte is equal to 8 bits. The specified field lengths do not include the null character used to terminate variable length strings. The Message Type and Message Length fields comprise the Message Header.

The order of transmission of the data described in this document is resolved to the byte level. Whenever a diagram shows a group of bytes, the order of transmission of those bytes is the

normal order in which they are read in English. In Figure 4-5 the bytes are transmitted in the order they are numbered. Whenever a byte represents a numeric quantity, the left most bit in the diagram is the high order or most significant bit. That is, the bit labeled 0 is the most significant bit. Figure 4-6 represents the value 170 (decimal). Similarly, whenever a multi-byte field represents a numeric quantity, the left most bit of the whole field is the most significant bit. When a multi-byte quantity is transmitted, the most significant byte is transmitted first.

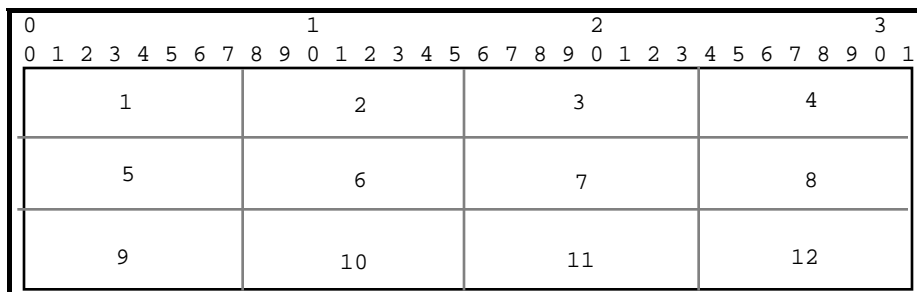


Figure 4-5. Transmission Order of Bytes

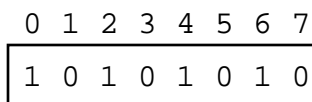


Figure 4-6. Significance of Bits

A control message is rejected when it contains errors or is sent in an inappropriate sequence. The message source receives notification of this rejection, via a control message from the message destination. Error conditions for each of the messages include out-of-bound parameter values, invalid parameter values, and missing parameter values (e.g., message type). In most cases, the message is corrected by the message source, and resent.

The message transfer scenario between TSDIS and TSS supports operator tunable parameters, which are included in the operations procedures for TSDIS and the TSS components of the GSFC DAAC, and are documented in the DAAC Operators Manual. Operator tunable parameters include time between sending a DAN and the time the data will be deleted from the file server if it has not been retrieved. TSS guarantees data to be available on the file server for at least 48 hours.

4.4.1 Data Availability Notice (DAN)

A DAN message is sent by the system supplying the data (TSDIS or TSS processor) to the Consumer System (system that receives the data) to announce the availability of data for transfer.

It specifies the parameters needed to identify what files are ready for pickup, their location, and how long they will be available in that location. The maximum message length allowed for a DAN sent between TSDIS and TSS is 1 megabyte (1,048,576 bytes). More than one DAN may be sent if needed.

Figure 4-7 shows the DAN message structure. Each DAN includes a Message Header, Exchange Data Unit (EDU) Label, a DAN Label and Parameter Value Language (PVL) Statements. The Message Header and labels are in a contiguous string, followed by the PVL. The labels and PVL statements are in Standard Formatted Data Unit (SFDU) format. (More information about SFDU and PVL can be found in the documents Consultative Committee for Space Data Systems (CCSDS), *Standard Formatted Data Units -- Structure and Construction Rules, Blue Book*, and Consultative Committee for Space Data Systems (CCSDS), *Parameter Value Language Specification (CCSDS0006), Blue Book*.)

Table 4-6 contains the Message Header and labels; Table 4-7 specifies the required parameters in the DAN PVL and their values. The DAN PVL statements are ASCII strings, each string having at most 256 characters, in the form of: "Parameter = Value;". The semi-colon at the end of each statement serves as the field delimiter. No blank (white) spaces are allowed immediately before the semi-colon. A carriage return (\n) may be added after the semi-colon, for human readability, but is not required. The string values shown in Table 4-7 include pre-defined ASCII values indicated in the table by single quote marks, and a description or range of processor determined values without quotes. These quotes are not used in the actual messages. Processor determined values include ASCII alphanumeric, ASCII numeric, and International Standards Organization (ISO) times to be filled in with the proper values by the originating system's processor during DAN creation. (ISO format is described in Consultative Committee for Space Data Systems (CCSDS), *Time Code Formats, Blue Book*.) The combination of the DAN sequence number and originating system (processor identifier) parameters uniquely identify each DAN and provides the link between related DAN, DAA, DDN, and DDA control messages. The FILE_SPEC and FILE_GROUP objects are repeatable within a single DAN, for multiple files and/or file groups. The TOTAL_FILE_COUNT parameter indicates the number of files to be retrieved. Sample PVL for DANs sent to or from TSDIS and TSS is shown in Figures 4-8 and 4-9.

DANs are validated to check that all required fields are present and that the format of the message is correct and consistent with the standards. In addition, TSDIS checks the actual values of the parameters in DANs from TSS. DANs that adhere to the defined message standards shown in Tables 4-6 and 4-7 are accepted and processed. If an entire DAN is determined to be invalid (e.g. invalid DAN sequence number) as reflected in the corresponding short DAA, none of its file groups are processed and none of the files are transferred. If a DAN contains multiple file groups for which one or more file groups contain DAN validation errors, the DAN is rejected and not processed; a long DAA is returned describing the disposition of each file group with errors.

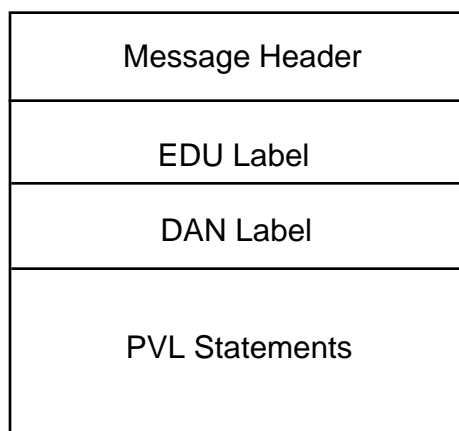


Figure 4-7. DAN Message Structure

Table 4-6. DAN Message Header, and EDU and DAN Labels

| Field | Description | Type (Length in Bytes) | Value |
|--------------------------|----------------------------|------------------------|------------------|
| Message Type | indicates DAN | Unsigned Integer (1) | 1 |
| Message Length | Length of Message in bytes | Unsigned Integer (3) | $\leq 1,048,576$ |
| Exchange Data Unit Label | Not used | ASCII (20) | 20 byte fill |
| DAN Label | Not used | ASCII (20) | 20 byte fill |

Table 4-7. Required DAN PVL Parameters (1 of 3)

| Parameter | Description | Type / Format (Maximum Length in Bytes) | Consumer System | Value |
|--------------------|---|--|-----------------|---|
| ORIGINATING_SYSTEM | Originator of DAN | Variable String / ASCII (20) | TSDIS or TSS | TSDIS Processor Identifier (Note 1) or TSS descriptive identifier |
| CONSUMER_SYSTEM | Destination of DAN | Variable String / ASCII (20) | TSDIS or TSS | TSS descriptive identifier or TSDIS Processor Identifier (Note 1) |
| DAN_SEQ_NO | Sequence number assigned by originating system | Unsigned 32-bit Integer / ASCII (10) | TSDIS or TSS | $\leq 4.295 * 10^9$ |
| REQUEST_TYPE | Type of request which applies to this DAN | Variable String / ASCII (10) | TSDIS | 'Subscription', 'Data Request' |
| ECS_ID | Identifier of corresponding Data Request or Data Subscription Request | Variable String / ASCII (20) | TSDIS | Unique ID in Data Request Acknowledgment or Data Subscription Acknowledgment |
| TOTAL_FILE_COUNT | Total number of files to transfer | Unsigned Integer / ASCII (4) | TSDIS or TSS | 0 - 9999 (0 is valid in response to a TSDIS Data Request) |
| AGGREGATE_LENGTH | Total number of bytes to transfer (sum for all files) | Unsigned 64-bit Integer / ASCII (20) | TSDIS or TSS | $\leq 1.844 * 10^{19}$ |
| EXPIRATION_TIME | ISO Time for data deletion from originating system | Fixed String / ASCII (20) | TSDIS or TSS | GMT in the format: yyyy-mm-ddThh:mm:ssZ where T and Z are literals (operations tunable time after DAN sent) |

Note 1. Each TSDIS processor must have a unique identifier that is registered as a TSS user.

Table 4-7. Required DAN PVL Parameters (2 of 3)

| Parameter | Description | Type / Format (Maximum Length in Bytes) | Consumer System | Value |
|--------------|---|--|-----------------|--|
| OBJECT | Start of file group parameters (repeat for each group of files) | Fixed String / ASCII (10) | TSDIS or TSS | 'FILE_GROUP' |
| DATA_TYPE | Data Type | Variable String / ASCII (20) | TSDIS or TSS | Valid Value, as listed in Tables 5-2 and 5-6 |
| NODE_NAME | Name or IP address of network node on which the file resides | Variable String / ASCII (64) | TSDIS or TSS | e.g. 'tsscbigtwy.nascom.nasa.gov' or '111.222.333.444' |
| OBJECT | Start of file parameters (repeat for each file) | Fixed String / ASCII (9) | TSDIS or TSS | 'FILE_SPEC' |
| DIRECTORY_ID | File directory name (i.e., path name) | Variable String / ASCII (256) (Note 2) | TSDIS or TSS | e.g. /PR/Level1 |
| FILE_ID | File name | Variable String / ASCII (256) (Note 2) | TSDIS or TSS | TSDIS Granule ID |
| FILE_TYPE | File Data Type | Variable String / ASCII (20) | TSDIS or TSS | 'BROWSE', 'SCIENCE' |

Table 4-7. Required DAN PVL Parameters (3 of 3)

| Parameter | Description | Type / Format (Maximum Length in Bytes) | Consumer System | Value |
|---------------------|---|--|-----------------|--|
| FILE_SIZE | Length of file in bytes | Unsigned 32-bit Integer / ASCII (10) | TSDIS or TSS | $\leq 2 * 10^9$ |
| BEGINNING_DATE/TIME | ISO Start time of data in file as defined in the metadata | Fixed String / ASCII (20) | TSDIS or TSS | GMT in the format: yyyy-mm-ddThh:mm:ssZ where T and Z are literals |
| ENDING_DATE/TIME | ISO End time of data in file as defined in the metadata | Fixed String / ASCII (20) | TSDIS or TSS | GMT in the format: yyyy-mm-ddThh:mm:ssZ where T and Z are literals |
| END_OBJECT | End of file parameters (repeat for each file) | Fixed String / ASCII (9) | TSDIS or TSS | 'FILE_SPEC' |
| END_OBJECT | End of file group (repeat for each file group) | Fixed String ASCII (10) | TSDIS or TSS | 'FILE_GROUP' |

```

ORIGINATING_SYSTEM = tsdismc;
CONSUMER_SYSTEM = tsscbigtwy;
DAN_SEQ_NO = 448;
TOTAL_FILE_COUNT = 2;
AGGREGATE_LENGTH = 20069451;
EXPIRATION_TIME = 1997-05-24T10:34:27Z;
OBJECT = FILE_GROUP;
    DATA_TYPE = 2A23;
    NODE_NAME = tsdisite.nascom.nasa.gov;
    OBJECT = FILE_SPEC;
        DIRECTORY_ID = /TSDISOPS/Pools/PR/17;
        FILE_ID = 2A23.970508.17.1.HDF;
        FILE_TYPE = SCIENCE;
        FILE_SIZE = 10034728;
        BEGINNING_DATE/TIME = 1997-05-08T00:12:00Z;
        ENDING_DATE/TIME = 1997-05-08T01:43:00Z;
    END_OBJECT = FILE_SPEC;
    OBJECT = FILE_SPEC;
        DIRECTORY_ID = /TSDISOPS/Pools/PR/18;
        FILE_ID = 2A23.970508.18.1.HDF;
        FILE_TYPE = SCIENCE;
        FILE_SIZE = 10034723;
        BEGINNING_DATE/TIME = 1997-05-08T01:43:00Z;
        ENDING_DATE/TIME = 1997-05-08T03:15:00Z;
    END_OBJECT = FILE_SPEC;
END_OBJECT = FILE_GROUP;

```

Figure 4-8 . Sample DAN PVL (TSDIS to TSS)

```

ORIGINATING_SYSTEM = tsscbigtwy;
CONSUMER_SYSTEM = tsdissmc;
DAN_SEQ_NO = 15326;
REQUEST_TYPE = Data Request;
ECS_ID = TSDIS1234;
TOTAL_FILE_COUNT = 2;
AGGREGATE_LENGTH = 349678;
EXPIRATION_TIME = 1998-11-10T20:00:00Z;
OBJECT = FILE_GROUP;
    DATA_TYPE = 1A11;
    NODE_NAME = tsscbigtwy.nascom.nasa.gov;
    OBJECT = FILE_SPEC;
        DIRECTORY_ID = /ftp/dist;
        FILE_ID = <tsdis file name>;
        FILE_TYPE = SCIENCE;
        FILE_SIZE = 242120;
        BEGINNING_DATE/TIME = 1998-11-08T18:36:18Z;
        ENDING_DATE/TIME = 1998-11-08T20:10:07Z;
    END_OBJECT = FILE_SPEC;
END_OBJECT = FILE_GROUP;
OBJECT = FILE_GROUP;
    DATA_TYPE = 2B11_BR;
    NODE_NAME = eosrv.gsfc.nasa.gov;
    OBJECT = FILE_SPEC;
        DIRECTORY_ID = /ftp/dist;
        FILE_ID = <tsdis file name>;
        FILE_TYPE = BROWSE;
        FILE_SIZE = 67561;
        BEGINNING_DATE/TIME = 1998-11-08T18:36:18Z;
        ENDING_DATE/TIME = 1998-11-08T18:43:07Z;
    END_OBJECT = FILE_SPEC;
END_OBJECT = FILE_GROUP;

```

Figure 4-9. Sample DAN PVL (TSS to TSDIS)

4.4.2 Data Availability Acknowledgment (DAA)

A DAA message is the corresponding handshake control message for the DAN. The DAA acknowledges receipt of the DAN and provides the mechanism to identify the status of data transfer scheduling and any DAN errors. The status of the DAN is provided in the disposition, where one of 32 bits is set to 1 to indicate which error occurred. The "Not used" bits are set to 0. The disposition reported in the DAA is where processing of the DAN stopped. A separate DAA is sent for each DAN. The short form of the DAA is used for both error-free DANs and DANs with the same disposition for all files. A long form of the DAA message is used when some file groups in the DAN have invalid parameters. The format and content of the short and long DAA messages is defined in Tables 4-8 and 4-9, respectively.

Table 4-8. Short DAA Message Definition

| Field | Description | Type (Length in Bytes) | Value |
|---------------------|---|------------------------|---|
| Message Type | Short Data Availability Acknowledgment | Unsigned Integer (1) | 2 |
| Message Length | Length of Message in Bytes | Unsigned Integer (3) | 13 |
| DAN Sequence No. | Sequence number assigned by DAN sender | Integer (4) | DAN_SEQ_NO in DAN |
| Disposition | Disposition Bits -- meaning: Accepted Not used Invalid DAN sequence number Not used Not used Not used Invalid file count Not used Consumer System internal error Not used Not used Invalid DAN length Invalid aggregate length Database failures Duplicate DAN sequence # Spares Invalid PVL statement Missing Originating System parameter | Logical Bits (4) | Bit location set to 1: none 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 - 25 26 27 |
| Transfer Start Time | Not used | Integer (1) | Null |

Table 4-9. Long DAA Message Definition

| Field | Description | Type (Length in Bytes) | Value |
|-----------------------------------|--|------------------------|--|
| Message Type | Long Data Availability Acknowledgment | Unsigned Integer (1) | 3 |
| Message Length | Length of Message in Bytes | Unsigned Integer (3) | Determined length of message in bytes |
| DAN Sequence No. | Sequence number assigned by DAN sender | Integer (4) | DAN_SEQ_NO in DAN |
| Number of File Groups (to follow) | Number of File Groups with Errors | Integer (4) | Number of File groups, in DAN, with errors |

For each file group having errors in the Data Availability Notice:

| | | | |
|------------------|--|----------------------------|--|
| Data Type value | Data Type | ASCII String (≤ 20) | DATA_TYPE in DAN |
| Descriptor value | Name of instrument/sensor that collected the data | ASCII String (≤ 60) | NULL |
| Disposition | Disposition bits -- meaning: Not used Invalid data type (Note 1) Not used Not used Invalid directory (Note 1) Not used Not used Not used Invalid file size field Not used Invalid time/date format Invalid file ID (Note 1) Not used Spare Invalid node name (Note 1) Invalid file type (Note 1) | Logical Bits (2) | Bit location set to 1: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 |

Note 1: NULL string check only for DANs from TSDIS; value check on DANs from TSS

4.4.3 Data Delivery Notice (DDN)

A DDN is sent from the system which has completed retrieving the files via ftp from the data provider, to the data consumer. The DDN announces the completion of data transfer, preprocessing, and archival, and identifies the success or reason for failure for each file. The short DDN is used for notification of the same disposition (including successful) for all files. The long DDN is used when at least one file has a different disposition. The format and content of the short and long DDN messages is defined in Tables 4-10 and 4-11, respectively. If the disposition is not 0 (successful), the value of the Time Stamp is Null (Null-filled 20 byte ASCII string), and the Throughput value is 0.

Table 4-10. Short DDN Message Definition

| Field | Description | Type (Length in Bytes) | Value |
|---|---|------------------------|---|
| Message Type | Short DDN | Unsigned Integer (1) | 11 |
| Message Length | Length of Message/Bytes | Unsigned Integer (3) | 40 |
| DRR Sequence No. | Not used | Integer (4) | 0 |
| DAN Sequence No. | Sequence number assigned by DAN sender | Integer (4) | DAN_SEQ_NO parameter in DAN |
| Disposition Note 1: Only used in DDNs from TSDIS to TSS. | One of the following: Successful Network failure (Note 1) Unable to establish ftp connection Host denied access (Note 1) File not found Ftp failure (Note 1) Post-transfer file size check failure Ftp command failure Metadata preprocessing error Resource allocation failure Data archive error Spares | Integer (1) | 0 1 2 3 4 5 6 7 8 9 10 11-251 |
| Spares | | (3) | |
| Time Stamp | ISO Time data transfer and validation completed | ASCII (20) | GMT in the format: yyyy-mm-ddThh:mm:ssZ where T and Z are literals (20 x '\0' if disp >0) |
| Throughput | Rate in bytes per second averaged over all files | Integer (4) | ≥0 (0 indicates disposition >0) |

Table 4-11. Long DDN Message Definition

| Field | Description | Type (Length in Bytes) | Value |
|---------------------------|---|-------------------------------------|---|
| Message Type | Long Data Delivery Notice | Unsigned Integer (1) | 12 |
| Message Length | Length of Message/ Bytes | Unsigned Integer (3) | Determined length |
| DRR Seq. No. | Not used | Integer (4) | 0 |
| DAN Sequence No. | Sequence number assigned by DAN sender | Integer (4) | DAN_SEQ_NO parameter in DAN |
| Number of Files | Number of Files in DAN | Integer (4) | TOTAL_FILE_COUNT parameter in DAN |
| File Directory | ASCII string specifying file directory/path name | ASCII(≤ 256) length of DIRECTORY_ID | DIRECTORY_ID parameter in DAN |
| File Name | File names on system sending DAN | ASCII (≤ 256) length of FILE_ID | FILE_ID parameter in DAN |
| File Transfer Disposition | One of the following: Successful Network failure (Note 1) Unable to establish ftp connection Host denied access (Note 1) File not found Ftp failure (Note 1) Post-transfer file size check failure Ftp command failure Metadata preprocessing error Resource allocation failure Data archive error Spares | Integer (1) | 0 1 2 3 4 5 6 7 8 9 10 11-251 |
| Time Stamp | ISO Time of completed data transfer and validation | ASCII (20) | GMT in the format: yyyy-mm-ddThh:mm:ssZ where T and Z are literals (20 x '0' if disp > 0) |
| Throughput | Rate in bytes per second for each file | Integer (4) | ≥ 0 (0 indicates disposition > 0) |

NOTE: The above set of parameters is repeated for each file in the Data Availability Notice

4.4.4 Data Delivery Acknowledgment (DDA)

A DDA is the corresponding handshake control message for the DDN. The DDA provides the mechanism for the provider of the data (i.e., ORIGINATING_SYSTEM as defined in the DAN PVL) to acknowledge receipt of the DDN. The format and content of the DDA message is defined in Table 4-12.

Table 4-12. DDA Message Definition

| Field | Description | Type (Length in Bytes) | Value |
|---------------------|---|------------------------|----------------------------|
| Message Type | Short Data Delivery Acknowledgment | Unsigned Integer (1) | 17 |
| Message Length | Length of Message in Bytes | Unsigned Integer (3) | 33 |
| DRR Sequence No. | Not used | Integer (4) | 0 |
| DAN Sequence Number | Sequence number supplied by Originating System | Integer (4) | DAN_SEQ_NO in DAN |
| Disposition | One of the following: Successful Not used Error processing DDN - resend an operations tunable time later Spares | Integer (1) | 0 1 2 3 - 255 |
| Time Stamp | ISO Time when Consumer System transferred the last part of the data | ASCII (20) | Null (20 x '\0') |

4.4.5 Data Request (DR)

The Data Request message is used by TSDIS to order products from TSS that are currently in the archive, in support of TSDIS. TSDIS can also forward a Data Request from TSUs to TSS. The volume of data ordered by TSDIS is defined in the IRD Between EOSDIS and the TRMM Ground System. Tables 4-13 and 4-14 define the contents and format of the Data Request message header and PVL. The DESTINATION_USER parameter in the PVL indicates where the DAN will be sent, and therefore who will receive the data being requested. If TSDIS is to receive the data, the DESTINATION_USER parameter is set to the TSDIS processor ID to which TSS will send the DAN handshake control message. If the DESTINATION_USER is a TSU User ID the TSU is notified via e-mail when the requested data are ready to be retrieved by ftp, or when the data are physically mailed out on the requested MEDIA_TYPE. The DELIVERY_TYPE parameter indicates whether the delivery will occur via ftp or media; if 'media', then MEDIA_TYPE is set to '8 mm tape'. TSDIS does not receive data on media; however, TSUs may request tape delivery.

Data are requested, in a single Data Request, either by TSDIS FILE_ID (whole file name, which is the TSDIS Granule ID) or by a search of time range parameters contained in the SEARCH_GROUP object, not both. The FILE_ID parameter is repeatable within the FILE_GROUP object in the Data Request PVL, to accommodate ordering more than one FILE_ID; the FILE_GROUP object is not repeatable. The SEARCH_GROUP object is not repeatable so only one search can be performed per Data Request.

TSDIS provides the file IDs to TSS when the data are originally sent by TSDIS to TSS, via the FILE_ID parameter in the DAN (see Section 4.4.1) and in the product specific metadata. The IDs are a combination of TSDIS data type, orbit number, and time associated with the data. Browse file IDs always end with ".BRO". TSS uses the same FILE_IDs in the DAN for notification of data availability after TSDIS orders the data for reprocessing and for e-mail notification to TSUs of data availability after TSDIS orders data for them. The files are accordingly also distributed with those same names. Metadata files (ASCII, in ODL format) are distributed along with the product data files.

When TSS stages data for TSDIS on behalf of a SEARCH_GROUP Data Request, then if there are multiple versions of requested products, only the most recently archived product versions are staged.

Table 4-13. Data Request

HEADER

| Field | Description | Type (Length in Bytes) | Value |
|----------------|----------------------------|------------------------|-------------------|
| Message Type | Indicates Data Request | Unsigned Integer (1) | 30 |
| Message Length | Length of Message in bytes | Unsigned Integer (3) | Determined length |

Table 4-14. Data Request**PVL**

| Parameter | Description | Type /Format (Max Length in Bytes) | Valid Values |
|----------------------|--|---|--|
| ORIGINATING_SYSTEM | Originator of data request | Variable String / ASCII (20) | TSDIS Processor ID e.g., 'TSDIS1' (Note 1) |
| DESTINATION_USER | TSU User ID or TSDIS Processor ID to which TSS sends DAN | Variable String / ASCII (20) | TSU User ID or TSDIS Processor ID |
| DR_SEQ_NO | Sequence number assigned by TSDIS | Unsigned 32-bit Integer / ASCII (10) | $\leq 4.295 \times 10^9$ |
| DELIVERY_TYPE | Type of delivery to use | Variable String / ASCII (10) | 'ftp_pull' or 'media' |
| MEDIA_TYPE | If DELIVERY_TYPE is media, specify media type | Fixed String / ASCII (10) | '8 mm tape' |
| OBJECT | Start of File group | Fixed String / ASCII (10) | 'FILE_GROUP' |
| FILE_ID | TSDIS File_ID in ASCII (1 file per granule) - Repeatable within the File Group | Variable String / ASCII (48) | Valid TSDIS FILE_ID as defined in the DAN FILE_ID and the product metadata |
| END_OBJECT | End of File Group | Fixed String / ASCII (10) | 'FILE_GROUP' |
| OBJECT | Start of search group parameters | Fixed String / ASCII (12) | 'SEARCH_GROUP' |
| DATA_TYPE | Data Type | Variable String / ASCII (20) | Valid Value as listed in Tables 5-2 and 5-6 of this document |
| BEGINNING_DATE/ TIME | ISO Start time of data, as supplied in the metadata | Fixed String / ASCII (20) | GMT in the format: yyyy-mm-ddThh:mm:ssZ where T and Z are literals |
| ENDING_DATE/TIME | ISO End time of data, as supplied in the metadata | Fixed String / ASCII (20) | GMT in the format: yyyy-mm-ddThh:mm:ssZ where T and Z are literals |
| END_OBJECT | End of search group | Fixed String / ASCII (12) | 'SEARCH_GROUP' |

Note 1: Each TSDIS processor ID must be registered as an TSS user.

```

ORIGINATING_SYSTEM = tsdissmc;
DESTINATION_USER = tsdissmc;
DR_SEQ_NO = 992;
DELIVERY_TYPE = ftp_pull;
OBJECT = SEARCH_GROUP;
  DATA_TYPE = 1B21;
  BEGINNING_DATE/TIME = 1995-11-01T00:00:00Z;
  ENDING_DATE/TIME = 1995-11-02T00:00:00Z;
END_OBJECT = SEARCH_GROUP;

```

Figure 4-10 Sample Search_Group DR PVL (TSDIS to TSS)

```

ORIGINATING_SYSTEM = tsdissmc;
DESTINATION_USER = TSU user ID;
DR_SEQ_NO = 526;
DELIVERY_TYPE = ftp_pull;
OBJECT = FILE_GROUP;
  FILE_ID = 3A25.960418.1.HDF;
  FILE_ID = 3A25.960423.1.HDF;
END_OBJECT = FILE_GROUP;

```

Figure 4- 11 Sample File_Group DR PVL (TSDIS to TSS)

4.4.6 Data Request Acknowledgment (DRA)

TSS sends a DRA in response to a Data Request. The DRA message notifies TSDIS that either the Data Request has been received, properly parsed, and queued by the TSS data server or is incorrectly formulated and has been rejected. It also provides TSDIS with a unique ID, for future use in correlating with the DAN received from TSS upon staging for retrieval. Table 4-15 defines the content and format of the DRA header and PVL. The DRA reports a disposition which rejects the Data Request if the Data Request is formulated incorrectly (i.e., the required parameters are not present for either a FILE_GROUP object or a SEARCH_GROUP object).

Table 4-15. Data Request Acknowledgment**HEADER**

| Field | Description | Type (Length in Bytes) | Value |
|----------------|---|------------------------|--------|
| Message Type | Data Request Acknowledgment | Unsigned Integer (1) | 31 |
| Message Length | Length of Message in Bytes | Unsigned Integer (3) | ≤ 119 |
| Disposition | One of the following: Successful Validation failure | Integer (1) | 0 1 |

PVL

| Field | Description | Type /Format (Max Length in Bytes) | Value |
|--------------------|--|---------------------------------------|--------------------------------------|
| ECS_ID | TSS-returned ID of submitted Data Request | Variable String / ASCII (20) | unique ID |
| ORIGINATING_SYSTEM | Originator of Data Request | Variable String / ASCII (20) | TSDIS Processor ID from Data Request |
| DESTINATION_USER | TSU user ID or TSDIS processor ID DAN destination (final data destination) | Variable String / ASCII (20) | DESTINATION_USER in Data Request |
| DR_SEQ_NO | Associated Data Request Sequence Number | Unsigned 32-bit Integer / ASCII (10) | ≤ 4.295*10 ⁹ |

```
ECS_ID = 0000000993;
ORIGINATING_SYSTEM = tsdissmc;
DESTINATION_USER = tsdissmc;
DR_SEQ_NO = 993;
```

Figure 4-12 . Sample DRA PVL (TSS to TSDIS)

4.4.7 Metadata Update Request (MUR)

After the TSU's Scientists have completed evaluating the products, they will need to update Quality Flag metadata parameter values that were not known at the time of initial product archive. TSDIS sends TSS a Metadata Update Request containing the file (granule) ID of the product; and the metadata parameters and values to be updated. Table 4-16 defines the content and format of the MUR header and PVL. A MUR will contain one or more file groups.

Table 4-16. Metadata Update Request

HEADER

| Field | Description | Type (Length in Bytes) | Value |
|----------------|----------------------------|------------------------|-------------------|
| Message Type | Metadata Update Request | Unsigned Integer (1) | 42 |
| Message Length | Length of Message in Bytes | Unsigned Integer (3) | Determined length |

PVL

| Parameter | Description | Type / Format (Max Length in Bytes) | Valid Values |
|--------------------|---|--|--|
| ORIGINATING_SYSTEM | Originator of Metadata Update Request | Variable String / ASCII (20) | TSDIS Processor ID |
| MUR_SEQ_NO | Metadata Update Request Sequence number assigned by TSDIS | Unsigned 32-bit Integer / ASCII (10) | $\leq 4.295 \times 10^9$ |
| OBJECT | Start of File group (repeat File groups for multiple values of Quality Flag) | Fixed String / ASCII (10) | 'FILE_GROUP' |
| FILE_ID | TSDIS FILE_ID in ASCII one per FILE_GROUP) | Variable String / ASCII (64) | Valid TSDIS FILE IDs |
| QUALITY_FLAG | Science quality flag (TSDIS QA Parameter Value) for FILE ID listed in 'FILE_GROUP' (one per file group) | Variable String / ASCII (27) | 'NOT BEING INVESTIGATED', 'BEING INVESTIGATED', 'FAILED', or 'PASSED' |
| END_OBJECT | End of file group | Fixed String / ASCII (10) | 'FILE_GROUP' |

```

ORIGINATING_SYSTEM = tsdissmc;
MUR_SEQ_NO = 63;
OBJECT = FILE_GROUP;
  FILE_ID = 3A26.960413.1.HDF;
  QUALITY_FLAG = FAILED;
END_OBJECT = FILE_GROUP;
OBJECT = FILE_GROUP;
  FILE_ID = 3A26.960418.1.HDF;
  QUALITY_FLAG = PASSED;
END_OBJECT = FILE_GROUP;

```

Figure 4- 13 Sample MUR PVL (TSDIS to TSS)

4.4.8 Metadata Update Acknowledgment (MUA)

TSS sends a MUA in response to a Metadata Update Request. The MUA message notifies TSDIS that either the Metadata Update Request has been received, properly parsed, and the requested Quality Flag metadata parameters have been updated (disposition equals 0) or the request is incorrectly formulated and has been rejected. Table 4-17 defines the content and format of the MUA.

Table 4-17. Metadata Update Acknowledgment

HEADER

| Field | Description | Type (Length in Bytes) | Value |
|----------------|----------------------------------|------------------------|--------|
| Message Type | Metadata Update Acknowledgment | Unsigned Integer (1) | 43 |
| Message Length | Length of Message in Bytes | Unsigned Integer (3) | ≤ 35 |
| Disposition | Successful Validation failure | Integer (1) | 0 1 |

PVL

| Field | Description | Type /Format (Max Length in Bytes) | Value |
|--------------------|--|--|---|
| ORIGINATING_SYSTEM | Originator of Metadata Update Request | Variable String / ASCII (20) | TSDIS Processor ID from Metadata Update Request |
| MUR_SEQ_NO | Associated Metadata Update Request Sequence Number | Unsigned 32-bit Integer / ASCII (10) | ≤ 4.295*10 ⁹ |

```

ORIGINATING_SYSTEM=tsdissmc;
MUR_SEQ_NO=62;

```

Figure 4-14 Sample MUA PVL (TSS to TSDIS)

4.4.9 Granule-Standing-Order Map

TRMM Science Users (TSUs) have standing order requirements that include such features as content-based searching and coincidence searching. Consequently, TSDIS will generate and send to the TSS daily maps with the granules desired by a given TSU. The TSU Standing Order function is a DAAC-unique component provided by the GSFC DAAC on behalf of TSDIS under an internal GCDC agreement. However, the interface specifications to support implementation of this function are included herein for completeness.

The Granule-Standing-Order map is sent once a day from TSDIS to TSS via email, to the address **submap@lake.gsfc.nasa.gov**, where it is automatically processed to generate data requests for the TSUs. (This name may be different during testing.) The email is ASCII formatted with 1 record per line. A record consists of a USER_NAME, TSDIS FILE_ID, TSDIS ORDER_ID and DATE_STRING. The fields are delimited by single spaces. The USER_NAME is entered beforehand by DAAC staff into the TSS database along with user profile information supplied by TSDIS. The ORDER_ID is a number assigned by TSDIS which ties together multiple granules which are considered to fulfill the same standing order. (The TSS ignores this number when processing the Granule-Standing order Map.) The DATE_STRING is for TSDIS troubleshooting purposes, and is ignored by the TSS.

If no granules meet the standing order criteria for that day, the email is not sent. Also, only granules that have already been acknowledged via DDN as successfully ingested will be included in a given Granule-Standing-Order Map.

Table 4-18. Granule-Standing order Map

| Field | Description | Type (Length in Bytes) | Value |
|--------------|---|-----------------------------|------------------------|
| User Name | Short name identifying user, all uppercase. | String (≤ 10) | USER_NAME |
| File Name | File which should be added to the user's order | String (≤ 45) | TSDIS FILE_ID |
| Order Number | Order number assigned by TSDIS which ties together multiple granules which are considered to fulfill the same standing order. | ASCII Integer (≤ 10) | TSDIS ORDER_ID |
| Date String | Date string in the format m[m]/d[d]/yyyy | ASCII Integer (8-10) | Date of standing order |

Example Granule-Standing-Order Map

```
RSTEEL 2A23.IP.951101.1701 50000043 11/1/1995
RSTEEL 2A23.IP.951101.1702 50000043 11/1/1995
```

5. Product/Data Flow Descriptions

This section defines the contents and formats for each Data Flow between TSDIS and TSS. Many of these flows are based on common formats which are described in Section 5.1; metadata is addressed in Section 5.2. Sections 5.3 through 5.7 define the product transfer information for each TSS-TSDIS interface, including the frequency. Product volumes are documented in the Interface Requirements Document (IRD) Between the Earth Observing System Data and Information System (EOSDIS) and the Tropical Rainfall Measuring Mission (TRMM) Ground System and detailed in Appendix B of the TSDIS Requirements Document. Figure 5-1 shows the product data flows defined by this ICD.

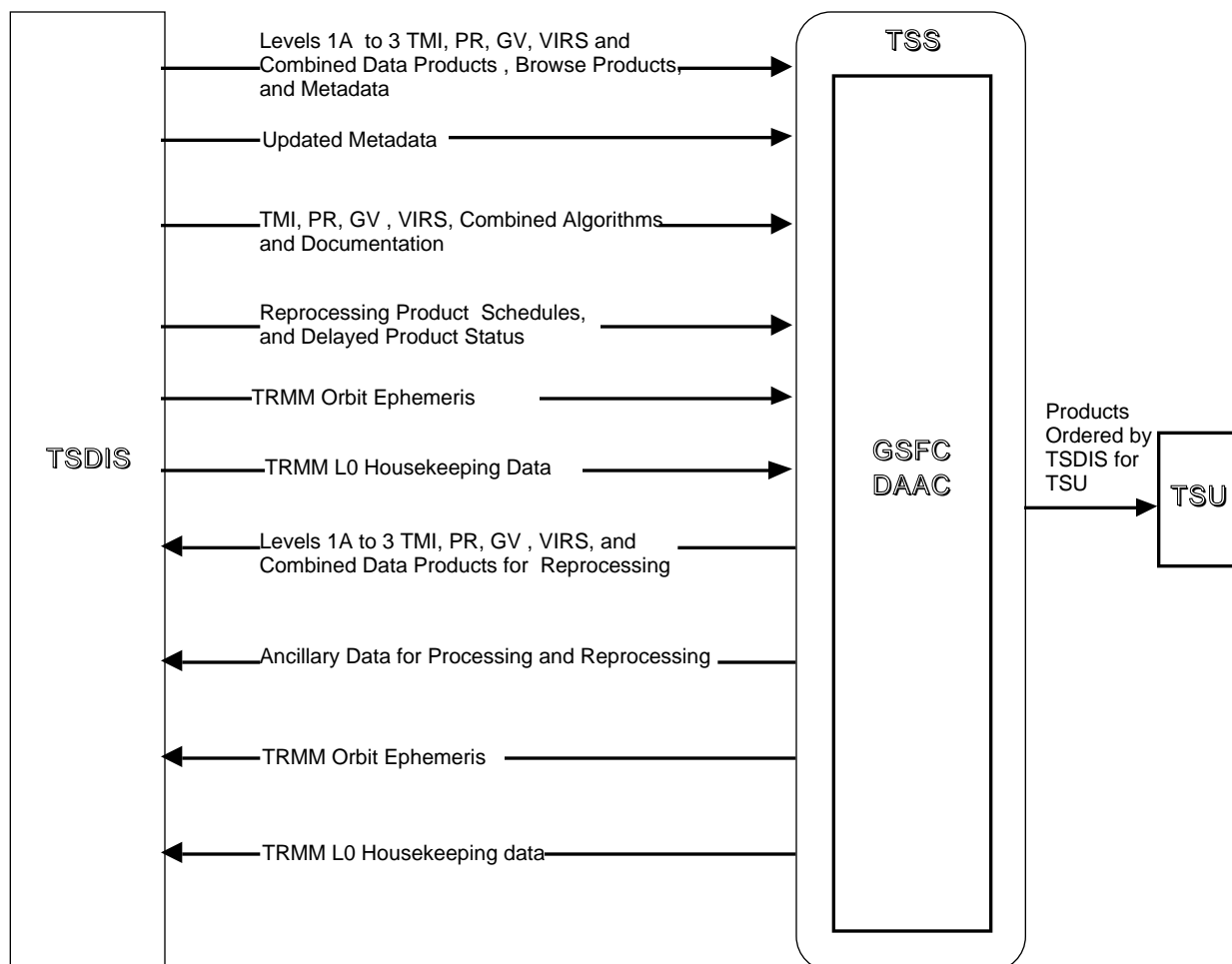


Figure 5-1. Data Flows Between TSS and TSDIS

5.1 HDF-EOS Data Taxonomy

The Hierarchical Data Format (HDF) is used to transfer products between TSS and TSDIS. All levels of TSDIS data products above level 1A, except GV level 2A52 data, as well as browse packages, are in HDF-EOS format (except GV radar data products, which use the TSDIS-defined HDF radar grid structure). The basis of the HDF-EOS format is a file organization which can support a variety of data models for accessing scientific and related data. These data models include 8-bit and 24-bit raster images and associated palettes, multi-dimensional arrays of Scientific Data Sets (SDS), annotation for the representation of ASCII data, binary tables (Vdata), and Vgroup structures to create user defined relational objects. A browse product includes one or more raster images with associated palettes, tables of numbers, and text. Table 5-1 lists HDF-EOS data types as described in the HDF-EOS Primer for Version 1 EOSDIS.

Table. 5-1 HDF-EOS Data Types

| Data Type | Definition | SubTypes |
|---------------------|-------------------------|------------------------------|
| ASCII Text | Descriptive Text | Plain, Formatted |
| P=V Metadata (ODL) | Parameter=Value Info | Binary, Text |
| Science Data Table | Tabular Data | Standard, Index |
| Image | Raster Image | 8-bit Image, 24-bit Image |
| N-Dimensional Array | array of science data | Array of Records, of Scalars |
| Grid | Data projected on grid | Rectangular, Structured Grid |
| Swath | Satellite ground track | Simple, Complex |
| Point | Station Data | Standard, Index |
| Data Dictionary | Dictionary of P=V words | N/A |
| Structure | Group of Data types | N/A |

The contents and formats of all the TSDIS products in HDF-EOS format have been mutually agreed upon by TSDIS and TSS, are documented in the October 1996 (Volumes 3 and 4) and June 1996 (Volume 5) version of the *Interface Control Specification Between the TSDIS and the TSU*, TSDIS P-907, and are supported by TSS throughout the lifetime of the TRMM mission.

5.2 Metadata

TSDIS provides core and product-specific metadata with each science and browse product, derived from TSDIS processing and reprocessing. The metadata is included in the global file attributes in ODL format within each HDF-EOS (or HDF) file. This metadata is documented in Volume 3 of the *Interface Control Specification Between the TSDIS and the TSU*, dated October 1996 TSDIS P-907.

TSDIS provides metadata with each document archived at TSS as described in Section 5.3.2, and also provides to TSS, upon request as defined in an operations agreement, information to populate the advertisements and guides produced by TSS, and updates to TSS when this information changes. The GSFC DAAC will derive collection-level metadata from TSDIS and TRMM Project documentation, with supplemental assistance via personal communication with TSDIS as necessary. TSDIS provides the TSDIS granule ID in the metadata for each granule. TSDIS also provides the agreed upon metadata parameters needed for TSS to map browse granules to the science files used to create them.

5.3 TSDIS to TSS/GSFC Interface

The purpose of this interface is for TSS at the GSFC DAAC to receive and ingest data products, algorithms, and documentation from TSDIS. TSS archives and distributes these data products as a service for TSDIS. Data are delivered electronically, following the message and data flow shown in Figure 4-1, unless noted otherwise.

5.3.1 TRMM TMI, PR, VIRS, Combined, and GV Data and Products

These data include TMI, PR, and VIRS level 1A data; levels 1B through 3B standard science data products derived from TMI, PR, and VIRS instrument data via TSDIS processing and reprocessing; levels 1B to 3A ground validation (GV) data products derived from 11 ground radar sites; levels 2B and 3B combined products; and associated browse products. TSS/GSFC receives from TSDIS 24 hours worth of processed data products daily (except level 3 products, which are made available to TSS/GSFC at 5-day and 1-month intervals), and 2 days worth of reprocessed data products daily during reprocessing periods. Science products must be inserted into the TSS archive either before or at the same time as the associated browse products due to TSS mapping; therefore, TSDIS either sends them in the same DAN or the browse files in a later DAN. The approximate numbers of files of TMI, PR, VIRS, GV, and combined processed products, their frequency of transfer from TSDIS, and DATA_TYPE values used for the control messages (both science and browse, as applicable), are listed in Table 5-2. The number of files may change, but the total volume is as specified in the IRD Between the EOSDIS and the TRMM Ground System. The data products, formats and contents are detailed in the *Interface Control Specification Between the Tropical Rainfall Measuring Mission Science Data and Information System (TSDIS) and the TSDIS Science User (TSU)*, TSDIS P-907, dated June 1996 (Volume 5) and October 1996 (Volumes 3 and 4). Additions or changes to the DATA_TYPE values and products/algorithms must be agreed upon by TSS and TSDIS, and incorporated into Table 5-2.

Table 5-2. TSDIS Product DATA_TYPES, Algorithms, and Frequencies

| DATA_TYPE Value | Algorithm Names | Total # Science Files/ Frequency | #Browse files / frequency |
|----------------------------|--|---|--------------------------------------|
| Science (Browse) | | | |
| 1A01 (none) | 1A-VIRS | 16 files/Day | 0 |
| 1A11 (none) | 1A-TMI | 16 files/Day | 0 |
| 1A21 (none) | 1A-PR | 16 files/Day | 0 |
| 1B01 (1B01_BR) | VIRS Radiance | 16 files/ Day | 1 file/Day |
| 1B11 (1B11_BR) | TMI Brightness Temperatures | 16 files/Day | 1 file/Day |
| 1B21 (1B21_BR) | PR Power | 16 files/Day | 1 file/Day |
| 1B51 (none) | GV Calibration | 96 files/Day | 0 |
| 1C21 (1C21_BR) | PR Reflectivities | 16 files/Day | 1 file/Day |
| 1C51 (1C51_BR) | GV QC Radar Reflectivity | 264 files/Day | 11 files /Day |
| 2A12 (2A12_BR) | TMI Profiling | 16 files/Day | 1 file/Day |
| 2A21 (2A21_BR) | PR Surface Cross Section | 16 files/Day | 1 file/Day |
| 2A23 (2A23_BR) | PR Qualitative | 16 files/Day | 1 file/Day |
| 2A25 (2A25_BR) | PR Profile | 16 files/Day | 1 file/Day |
| 2A52 (none) | GV Rain Existence | 11 files /Day | 0 |
| 2A53 (2A53_BR) | GV Radar Site Rain Map | 264 files/Day | 11 files/Day |
| 2A54 (2A54_BR) | GV Radar Site Conv./Stratiform Map | 264 files/Day | 11 files/Day |
| 2A55 (2A55_BR) | GV Radar Site 3-D Reflectivities | 264 files/Day | 11 files/Day |
| 2A56 (none) | GV Rain Gauge | 11 files/Day | 0 |
| 2A57 (none) | GV Disdrometer | 11 files/Day | 0 |
| 2B31 (2B31_BR) | TRMM Combined | 16 files/Day | 1 file/Day |
| 3A11 (3A11_BR) | TMI Emission | 1 file/Month | 1 file/Month |
| 3A25 (3A25_BR) | PR Rainfall | 1 file/Month | 1 file/Month |
| 3A26 (3A26_BR) | PR Surface Rain | 1 file/Month | 1 file/Month |
| 3A53 (3A53_BR) | GV 5-day Site Rain Map | 11 files/5 days | 11 files/5 Days |
| 3A54 (3A54_BR) | GV 30-day Site Rain Map | 11 files/Month | 11 files/Month |
| 3A55 (3A55_BR) | GV Monthly 3D-Structure | 11 files/Month | 11 files/Month |
| 3B31 (3B31_BR) | Rainfall Combined | 1 file/Month | 1 file/Month |
| 3B42 (3B42_BR) | TRMM and Others GPI Calibration | 1 file/5 Days | 1 file/5 Days |
| 3B43 (3B43_BR) | TRMM and Others Data Sources | 1 file/Month | 1 file/Month |
| 3A46 (none) | TRMM and Others SSM/I Monthly Gridded Rainfall | 1 file/Month | 0 |
| TRMM EPHM | TRMM Orbit Ephemeris | 1 file/Day | 0 |
| TRMMHSK | TRMM L0 Housekeeping | 1 file/Day | 0 |

5.3.2 TRMM Orbit Ephemeris

TSS/GSFC receives the TRMM orbit ephemeris from TSDIS daily. This is the definitive and predictive orbit data which TSDIS receives from the Sensor Data Processing Facility (SDPF).

The orbit ephemeris is the binary EPHEM format produced by the FDF, which is referenced in Section 10 of the ICD Between the SDPF and the TRMM Consumers ICD. Each 9-day ephemeris file contains 34 hours worth of definitive orbit data. The DATA_TYPE for the ephemeris is provided in Table 5-2.

5.3.3 TRMM Level 0 Housekeeping Data

TSS/GSFC receives these data from TSDIS daily. This is the housekeeping file which TSDIS receives from the SDPF each day. The format and content of these data is documented in the TRMM Telemetry and Command Handbook and in Section 10 of the ICD Between the SDPF and the TRMM Consumers ICD. The DATA_TYPE for the housekeeping file is provided in Table 5-2.

5.3.4 TRMM TMI, PR, VIRS, Combined, and GV Algorithms and Documentation

TSS/GSFC receives algorithms and related documentation from TSDIS initially before launch, then after they have been updated for data reprocessing. Updates are anticipated at 6, 12, 24, and 36 months after instrument checkout. In addition, algorithms may be updated at 45 days and 4 months after instrument checkout. (Note, however, that there is no restriction on when the data may be sent to TSS.)

For each algorithm/product, TSDIS provides TSS with an algorithm package (AP), which consists of (1) a text file containing a pre-tar listing of the AP files; (2) the algorithm source code (SSAP) in a tar file; (3) a User's Guide describing the algorithm and its usage (in ASCII format); (4) other related documents (in ASCII format); and (5) metadata files (in ASCII format) associated with these preceding files.

Other related documents (#4) include guide documents for sensors, platform, mission, and data products. TSS provides TSDIS with templates for these guide documents, to be completed by TSDIS¹. For data product guide documents, TSS first fills out the template, to the extent possible. TSS emails to TSDIS the partially filled product guide document template as an ASCII attachment. TSDIS and/or the TSUs then fill out the rest of the template¹.

The required metadata parameters for the AP file listing, the source code tar file, and the documents are described in Tables 5-3, 5-4, and 5-5, respectively. TSS provides TSDIS with a template for the metadata, to be completed by TSDIS¹.

Delivery for each algorithm/product begins when TSDIS sends TSS an email notification in the following format:

Subject: TSDIS AP and documentation delivery (pre-launch|instrument checkout + 6|IT + 12|IT + 24|IT + 36)

Total number of files: n

¹ To the extent possible, within budget, time and personnel resources.

Machine name where 1st file is located

Full path and name of 1st file

Size of 1st file

Description of 1st file, or title if User's Guide or other documentation

.

.

.

Machine name where nth file is located

Full path and name of nth file

Size of nth file

Description of nth file, or title if User's Guide or other documentation

Any needed clarifications or corrections to the TSDIS delivery email are made via email between TSS and TSDIS. On receipt of TSS email acknowledgment of (possibly clarified or corrected) TSDIS delivery email, TSDIS places files to be transferred in a TSDIS directory accessible by TSS via ftp. After the file transfers are completed, TSS sends an email notification to TSDIS.

Table 5-3. Required Metadata Parameters for AP Listing

| Parameter | Type / Format (Maximum Length in Bytes) | Value |
|--------------------------------|---|--|
| AlgorithmPackageName | Variable String / ASCII (80) | TSDIS-defined name of AP |
| AlgorithmPackageVersion | Variable String / ASCII (20) | TSDIS-defined version of AP |
| AlgorithmPackageAcceptanceDate | Fixed String / ASCII (10) | Date of acceptance by TSDIS, in format: YYYY/MM/DD |
| DeliveryPurpose | Variable String / ASCII (20) | e.g. 'Algorithm update' |
| PGENAME | Fixed String / ASCII (9) | Name of Executable |
| PGEVersion | Float / ASCII (20) | Version of Executable |
| PGEDateLastModified | Fixed String / ASCII (10) | Date algorithm last modified, in format: YYYY/MM/DD |

Table 5-4 Required Metadata Parameters for Source Code Tar File

| Parameter | Type / Format (Maximum Length in Bytes) | Value |
|--------------------------|---|---|
| SSAPAlgorithmPackageName | Variable String / ASCII (80) | same as AlgorithmPackage Name in Table 5-3 |
| SSAPInsertDate | Fixed String / ASCII (10) | Date of insert of SSAP by TSDIS into TSS archive, in format: YYYY/MM/DD |
| SSAPAlgPackageVersion | Variable String / ASCII (20) | same as AlgorithmPackageVersion in Table 5-3 |

Table 5-5 Required Metadata Parameters for Document File

| Parameter | Type/Format (Maximum Length in Bytes) | Value |
|-------------------------|---------------------------------------|--|
| Title | Variable String/ASCII(255) | Title of document |
| DocumentVersion | Variable String/ASCII(8) | Version of document |
| DocumentCreated | Fixed String/Date(14) | Date document created in format: yyyy-mm-dd |
| DocumentUpdated | Fixed String/Date(14) | Date document updated |
| AlgorithmPackageName | Variable String/ASCII(80) | Name of algorithm package (same as Table 5-3) |
| AlgorithmPackageVersion | Variable String/ASCII(20) | Version of the algorithm package (same as Table 5-3) |
| DescriptionType | Variable String/ASCII(64) | 'Programmers Guide' |
| AuthorName | Variable String/ASCII(64) | Name of author |
| AuthorAffiliation | Variable String/ASCII(64) | Author affiliation |
| AuthorEmailAddress | Variable String/ASCII(200) | Email address of author |

5.4 TSS/GSFC to TSDIS Interface

The purpose of this interface is for TSS at the GSFC DAAC to provide to TSDIS the following TSDIS and ancillary data products. Data are delivered electronically, following the message and data flow shown in Figure 4-2, unless noted otherwise.

5.4.1 TRMM TMI, PR, VIRS, Combined and GV Levels 1A-3B Data for Reprocessing

TSDIS submits Data Requests daily to TSS/GSFC, during reprocessing periods, for archived levels 1A through 3B of TMI, PR, VIRS, combined, and GV (except level 1A) standard data products, for the purpose of TSDIS reprocessing. The data products, formats and contents are

specified in the *Interface Control Specification Between the TSDIS and the TSU*, TSDIS P-907, dated October 1996 (Volumes 3 and 4) and June 1996 (Volume 5)

Note: TSDIS is scheduled to reprocess products at about 45 days after instrument checkout and 4, 6, 12, 24, and 36 months after instrument checkout. Instrument checkout is expected to end approximately 1 or 2 months after launch.

5.4.2 TRMM Orbit Ephemeris

TSDIS submits a Data Request, using the SEARCH_GROUP object to TSS/GSFC for orbit ephemeris data for product reprocessing. This is the definitive and predictive orbit data described in Section 5.3.2. The orbit ephemeris is the binary EPHEM format produced by the FDF, which is referenced in Section 10 of the ICD Between the SDPF and the TRMM Consumers ICD. Each 9-day ephemeris file contains 34 hours worth of definitive orbit data. The DATA_TYPE for the ephemeris, needed for the Data Request, is shown in Table 5-2.

5.4.3 TRMM Level 0 Housekeeping Data

TSS/GSFC provides these data, to TSDIS as needed, in response to a Data Request, using the SEARCH_GROUP object, from TSDIS. These data are the same as that described in Section 5.3.3. The format and content of these data is documented in the TRMM Telemetry and Command Handbook and in Section 10 of the ICD Between the SDPF and the TRMM Consumers ICD. The DATA_TYPE for the housekeeping file, needed for the Data Request, is shown in Table 5-2.

5.5 Ancillary Data

Based on the ancillary data specifications in this section, TSS enters the Data subscriptions for the ancillary data for use by TSDIS in generating processed data products. As soon as the ancillary data are received in the TSS/GSFC archive, the data are staged for retrieval, under the original data provider's names, and TSDIS is notified. Each day during reprocessing periods, TSDIS submits a Data Request for ancillary data products for data to be used for reprocessing on the following day.

Refer to the Interface Requirements Document (IRD) Between the Earth Observing System Data and Information System (EOSDIS) and the Tropical Rainfall Measuring Mission (TRMM) Ground System for more information on ancillary data volumes and requirements.

The DATA_TYPE values for the ancillary data products, used for ordering the data for reprocessing, are defined in Table 5-6. Any future products required by TSDIS must be approved by TSS, added to this table, and described in this section.

5.5.1 Climate Analysis and Monitoring System (CAMS)

TSS/GSFC provides the CAMS Global Raingauge Analysis data set, obtained from the Climate Prediction Center (CPC) at the National Oceanic and Atmospheric Administration's (NOAA) National Center for Environmental Prediction (NCEP), to TSDIS. This is a monthly product

which consists of 0.5 degree grids of SPHEREMAP-analyzed CAMS gauge data, in binary format.

5.5.2 GOES Precipitation Index (GPI)

TSS/GSFC provides the Global Geo-IR Satellite Merged-IR Precipitation, obtained from NCEP, to TSDIS. There is a single file for each quarter of the year (Jan-Mar, Apr-Jun, Jul-Sep, Oct-Dec) with each file containing 5-day (pentad) rainfall fields in units of mm/day mapped to a 2.5 x 2.5 degree grid, and with geographic coverage of +/- 40 degrees latitude.

5.5.3 Global Precipitation Climatology Center (GPCC)

TSS/GSFC provides the GPCC Global Raingauge SPHEREMAP-Analysis data set to TSDIS, in ASCII format. These are global gridded monthly mean rainfall totals (raingauge data with some satellite and model-generated data for oceans) in 2.5x2.5 degree bins and are produced at the GPCC in Germany and are updated yearly. TSS obtains the product from NOAA/NESDIS (National Environmental Satellite Data and Information Service).

5.5.4 National Meteorological Center (NMC) Final Analysis and Forecast System

TSS/GSFC provides the Final Analysis and Forecast System, Global Analysis (FNL) Gridded Data Product produced by the NMC (NCEP). TSS/GSFC obtains 4 files per day (one every 6 hours) from NOAA, via the GSFC DAAC for use by TSDIS. The FNL product is received at TSS in NOAA's GRIB In Binary (GRIB) format, which is described in NOAA Office Note 388 (ON 388). The product is available to TSDIS in the native GRIB format. (Refer to the Interface Control Document Between the EOSDIS Core System (ECS) and the Goddard Space Flight Center (GSFC) DAAC for more information.)

Table 5-6 Ancillary Data Sets

| DATA_ TYPE | Product Name | File Name | Frequency (files/day) | Filesize (MB/file) | Volume (MB/day) | File Format |
|---------------|---|--------------------------|--------------------------|-----------------------|--------------------|----------------|
| CAMS | CAMS Global Raingauge Analysis | cams_v00n.yyymm | 0.033 | 2.1 | 0.07 | bin |
| NMCFNL | NMC Final Analysis and Forecast System, Global Analysis (FNL) | gdas1.PGrbF00.yymmdd.hhz | 4 | 13.5 | 55 | GRIB |
| GPI | GOES Precipitation Index product GPI Merged IR | gpi_v00n.yypp-yypp | 0.011 | 1.0 | 0.01 | bin |
| GPCC | GPCC Global Raingauge | gpcc_v00n.yyymm | 0.03 | 0.1 | 0.004 | asc |

Where v00n = internal DAAC version number

yy = year ; mm = month ; dd = day ; hh = hour of product generation ; z = zulu time ;

pp = pentad number (range 1-73)

5.6 TSS to TSU Interface

The purpose of this interface is for TSS at the GSFC DAAC to provide to TSUs any of the TSDIS data products that TSDIS can order via a Data Request. Data are delivered following the message and data flow described in Section 4.3.3.

5.7 Product Schedules

5.7.1 TSDIS Product Schedule

The purpose of this interface is for TSDIS to provide TSS/GSFC with a schedule for reprocessing products, prior to each reprocessing period. This schedule is delivered via fax, hard copy, or e-mail, and serves as a guideline for TSS in DAAC operations planning.

5.7.2 TSDIS Delayed Product Status

The purpose of this interface is for TSDIS to notify TSS/GSFC of any problems in product processing that may impact DAAC operations. TSDIS notifies TSS as needed, via telephone, fax, hard copy, or e-mail, of an expected delay in product availability.

Appendix A. Abbreviations and Acronyms

| | |
|--------|---|
| AP | Algorithm Package |
| ASCII | American Standard Code for Information Interchange |
| CAMS | Climate Analysis and Monitoring System |
| CCB | Configuration Control Board |
| CCSDS | Consultative Committee for Space Data Systems |
| CDR | Critical Design Review |
| CERES | Clouds and Earth's Radiant Energy System |
| DAA | Data Availability Acknowledgment |
| DAAC | Distributed Active Archive Center |
| DAN | Data Availability Notice |
| DCN | Document Change Notice |
| DDA | Data Delivery Acknowledgment |
| DDN | Data Delivery Notice |
| DMR | Detailed Mission Requirements |
| DR | Data Request |
| DRA | Data Request Acknowledgment |
| EBnet | EOSDIS Backbone Network |
| ECS | EOSDIS Core System |
| EDU | Exchange Data Unit |
| EOS | Earth Observing System |
| EOSDIS | EOS Data and Information System |
| ESDIS | Earth Science Data and Information System |
| FDD | Flight Dynamics Division |
| FDF | Flight Dynamics Facility |
| FNL | Final Analysis and Forecast System, Global Analysis |
| ftp | File Transfer Protocol |

| | |
|--------|---|
| GB | Gigabyte |
| GOES | Geostationary Operational Environmental Satellite |
| GPCC | Global Precipitation Climatology Centre |
| GPI | GOES Precipitation Index |
| GRIB | GRid In Binary |
| GSFC | Goddard Space Flight Center |
| GSOP | Ground System Operations Project |
| GV | Ground Validation |
| HDF | Hierarchical Data Format |
| HTML | HyperText Markup Language |
| ICD | Interface Control Document |
| IP | Internet Protocol |
| IR | Infrared |
| IRD | Interface Requirements Document |
| ISO | International Standards Organization |
| LAN | Local Area Network |
| LIS | Lightning Imaging Sensor |
| MB | Megabyte |
| MUA | Metadata Update Acknowledgment |
| MUR | Metadata Update Request |
| NASA | National Aeronautics and Space Administration |
| NASDA | National Space Development Agency of Japan |
| NCEP | National Center for Environmental Prediction |
| NESDIS | National Environmental Satellite Data and Information Service |
| NMC | National Meteorological Center (NOAA) |
| NOAA | National Oceanic and Atmospheric Administration |
| ODL | Object Data Language |
| pdf | portable document format |
| PR | Precipitation Radar |

| | |
|-------|--|
| PVL | Parameter Value Language |
| QA | Quality Assurance |
| RFC | Request for Comments |
| RST | Remote Science Terminal |
| rtf | rich text format |
| SCF | Science Computing Facility |
| SDOC | Science Data Operations Center |
| SDPF | Sensor Data Processing Facility |
| SFDU | Standard Format Data Unit |
| SOCC | Science Operations Control Center |
| SSAP | Science Software Archive Package |
| SSM/I | Special Sensor Microwave/Imager |
| TBD | To Be Determined |
| TBR | To Be Resolved |
| TBS | To Be Supplied |
| TCP | Transmission Control Protocol |
| TMI | TRMM Microwave Imager |
| TRMM | Tropical Rainfall Measuring Mission |
| TSDIS | TRMM Science Data and Information System |
| TSS | TRMM Support System |
| TSU | TSDIS Science User |
| VIRS | Visible and Infrared Scanner |
| WWW | World Wide Web |

This page intentionally left blank.